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GEOLOGICAL SURVEY OF KENTUCKY.

JNO. R. PROCTER, DIRECTOR.

CHEMICAL REPORT

OF THE

COALS. SOILS. CLAYS, PETROLEUM, MINERAL WATERS ETC., ETC., OF KENTUCKY.

BY ROBERT PETER, M. D., ETC., ETC.,

CHEMIST TO THE SURVEY,

ASSISTED BY ALFRED M. PETER, S. M.

THE SEVENTH CHEMICAL REPORT IN THE NEW SERIES, AND THE ELEVENTH SINCE THE BEGINNING OF THE SURVEY.

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INTRODUCTORY LETTER.

CHEMICAL LABORATORY,
KENTUCKY GEOLOGICAL SURVEY,
LEXINGTON, KY., April 17, 1888.

JNO. R. PROCTER, ESQ.,
Director of Geological Survey of Kentucky:

DEAR SIR: I have the pleasure herewith to send you for publication, my report of the chemical work done in this Laboratory for the Geological Survey since the publication of my last report.

Very respectfully,
ROBERT PETER, M. D., ETC.,
Chemist to Kentucky Geological Survey.

CHEMICAL REPORT.

Of the more than 273 analyses reported in the following pages, 137 are of coals from 14 counties in the eastern coal field of Kentucky; the greater number of them being from Bell, Breathitt, Clay, Harlan, Leslie, Perry and Whitley counties; a comparatively few samples are from Johnson, Knott, Knox, Letcher, Laurel and Martin counties. In the Appendix, West Virginia is represented in the analyses of seven samples, for comparison with Kentucky coals, together with the analyses of many other coals received since this report was made.

Most of these coals would come under the head of semi-bituminous, splint, or block coal; some few are, no doubt, entitled to the name "bituminous coal," and some of them are cannel coals. With them are reported some with such high ash percentage as to cause them to be classed with the bituminous shales. These, however, are comparatively few in number, and most of them could be used for fuel in their immediate vicinity. Generally speaking, these coals are of very good quality, and many of them would answer admirably for the manufacture of coke, while some of the splint or block coals could, probably, be used without coking for smelting iron ores. In short, the coals of this, one of the two immense coal fields of Kentucky, will generally compare favorably with those of any other region in the world.

Comparing the ash percentages of the coals of the seven counties which furnished the greatest number of samples, we find the following results, viz.

COUNTIES.	No. of samples analyzed.	Highest ash percentage.	Lowest ash percentage.	Average ash of the whole.	Average exclusive of highest ash percentage.
Whitley . .	18	7.90	1.54	3.56	none excluded.
Bell . . .	11	8.40	1.80	4.28	none excluded.
Harlan . .	44	47.48	2.20	7.76	5.12 excluding 4 highest.
Leslie . .	11	16.00	4.00	8.19	7.40 excluding 1 highest.
Breathitt .	10	24.20	5.28	9.32	8.08 excluding 1 highest.
Clay . . .	9	32.00	5.80	9.79	7.00 excluding 1 highest.
Perry . .	13	16.80	2.56	9.88	8.48 excluding 1 highest.

Of course such a comparison as this, of a limited number of samples, might not apply to the products of the whole of the several counties in question, as other samples from coal beds not here represented might alter these averages materially, and it is proper to state that those coals or bituminous shales which give very large ash, should be excluded from such calculations. Moreover, it is generally found that cannel coals—which variety abounds in Breathitt county particularly—very generally give more ash than the softer coals.

The West Virginia coals gave the following results, viz.: The 7 samples gave—highest ash, 12.76 per cent.; the lowest, 2.40 per cent; the general average of their ash, 4.94 per cent.

In all these coals the sulphur ranges from 6.042 per cent. in what is really bituminous shale, of Clay county; 5.436 in this kind of shale from Harlan county, and 5.078 in cannel coal of Bell county, down to 0.420 in Harlan county coal, and 0.418 per cent. in coal of West Virginia. Generally the percentage of sulphur is comparatively moderate or small in these coals.

The thirty-nine *Cokes* analyzed were principally from Bell, Harlan and Knox counties, there being but one sample each from Laurel, Letcher and Whitley counties. West Virginia furnished 8 samples.

The 20 samples of coke from Bell county gave an average ash percentage of 7.83, but without the highest four, which would be excluded from this manufacture, the ash was only 6.97 per cent, the highest being 12.2 and lowest only 4.00; which compares favorably with the best cokes in the market. The percentage of carbon in the coke varied from 95.80 in F. Barner's to 85.30 in Jas. Meyers'.

The average ash of the 4 Harlan county cokes was 9.10 per cent. But excluding the highest, 17.9, the ash average is only 6.20 per cent. The 4 Knox county cokes gave an average of 5.20 per cent. of ash, including the highest, 8.40. The lowest being only 3.20. The 8 West Virginia cokes gave a general average of 6.47 per cent. of ash, including one at 9.10 per cent.

The sulphur is moderate or small in all these cokes which do not contain too much ash, ranging from 1.975 to 0.217 per cent.

Of the 51 soils, the analyses of which are herewith reported, 12 are from Ballard county; 15 from Calloway; 2 from Graves; 11 from Marshall, and 10 from McCracken; in all, 50 from the so-called Jackson Purchase; one only is from Jefferson county. Five other soils, from Clinton county, are reported in the Appendix.

The Jackson Purchase soils and subsoils, with the exception of those from the bottom lands of the Ohio, Obion and Tennessee rivers and Shannon creek, and the Oak and Hickory Flats, all contain but a small or moderate proportion of organic matters or humus. This is, probably, due to the circumstance that they, with the exceptions above noted, generally contain quite a large quantity of sand and insoluble silicates in proportion to their alumina. The exceptional soil, No. 2622, from the first bottom of Tennessee river, Calloway county, gave but 77.719 per cent. of siliceous residue; while the red sandy soil of Sandy Ridge, No. 2565, gave 93.385 per cent., the general range being from about 81. to 91. per cent.

This rather large proportion of sand, although it is very fine sand generally, and moderate proportion of alumina, cause these soils to be light and porous, easily worked or drained under favorable conditions.

Lime and phosphoric acid are small, or only moderate in quantity, in several of them, which may render necessary the use of calcareous and phosphatic fertilizers, but the potash is usually in good proportions; a few exceptions only being noticeable. This fact, as well as their light porous condition, allowing free penetration of the atmospheric agencies, with the absence of gravel or coarse sand, aids in making these soils favorable to tobacco culture.

All of the 26 clays, etc., reported, are from the Jackson Purchase. Six from Ballard county; 8 from Calloway; 5 from Graves; 1 from Hickman; 6 from Marshall, and 5 from McCracken county; mostly from the Tertiary and Quaternary formations. A few of the most siliceous or sandy of them are derived from decomposing chert or hornstone of the Lower Carboniferous siliceous group.

Many of them are highly refractory, and would make good fire-brick or furnace linings, or, possibly, glass pots. Some are white enough for fine pottery-ware. Some, composed mainly of very fine sandy material, would answer to mix with tough clays, or probably for glazing material or glass, or for the manufacture of water cement. Several of these siliceous clays have such a fine texture that they may be used as scouring or polishing material.

Some of them, containing much iron peroxide, may find their applications as cheap paints, for terra-cotta work or cheap pottery-ware.

The 3 iron ores from Bath county belong to the Clinton group, and present the general characteristics of the so-called Clinton Iron Ore.

BALLARD COUNTY.

MINERAL WATERS.

No. 2554—MINERAL WATER, *from the Kilgore Spring at Blandville: temperature (in August) 58° F. Slightly chalybeate.* Collected by R. H. Loughridge, August 19th, 1885. Sample in stone-ware gallon jug. Cork sealed.

Evaporated to dryness, it left 0.0674 per 1000 of *saline matters*, which lost 0.0030 of *organic matter* on ignition.

The saline matters consisted of chlorides, carbonates and sulphates of calcium, magnesium, potassium, sodium and iron, silica and a trace of Lithium. They are slightly alkaline in reaction.

The water is a good saline chalybeate.

No. 2555—MINERAL WATER, *from the McGee Spring, Blandville. Strongly chalybeate. Temperature* 60° *F.* (in August). Collected by R. H. Loughridge, August, 1885.

COMPOSITION IN 1,000 PARTS.

Carbonate of iron	0.0244
Carbonate of lime	.0108
Carbonate of magnesia	.0019
Chloride of magnesium	.0099
Chloride of sodium	.0053
Carbonate of soda	.0316
Sulphate of potash	.0072
Silica	.0156
Total solid matters	0.1067

It contains also traces of organic matters and ammonia. It appears to be a good alkaline saline chalybeate water.

BALLARD COUNTY.

SOILS AND SUBSOILS.

No. 2556—SOIL. *Crawfishy, on west fork of Mayfield creek, taken to the depth of* 10 *inches, near the bridge on the road from Blandville to Milburn.* Collected by R. H. Loughridge, 1884.

The dried soil contained small friable clods, is of a buff-grey color. The *coarse sieve*[*] removed only a few small fragments of stone. Its siliceous residue, after digestion in acids, all passed through the *fine sieve*,[†] except 16.5 per cent. of fine white quartz sand.

No. 2557—VIRGIN SOIL. *Ohio river bottom. Taken 8 inches deep from Clear Lake Ridge, elevated a few feet above the cypress swamps, and having a growth of white oak, hickory, gum, prickley ash, walnut and black locust. Undergrowth of cane.* Four miles west of Barlow. *Geological formation: Quaternary* brown loam table lands. Collected by R. H. Loughridge, 1884.

Dried soil in small friable clods of a dark grey-brown color. All passed through the coarse sieve, except a small quantity of vegetable debris. Its siliceous residue, from digestion in acids, all passed through the fine sieve, except a small quantity of fine white sand.

No. 2558—VIRGIN SOIL. *Obion bottom. South of Arlington. Taken to the depth of* 10 *inches.* Collected by R. H. Loughridge, 1884.

Dried soil in friable clods of a dark grey-brown color. All passed through the coarse sieve except a little vegetable debris. Its silicious residue all passed through the fine sieve.

No. 2559—VIRGIN UPLAND SOIL. *Brown loam from the Barrens or tobacco lands, one mile south-east of Hazlewood post-office. Taken to the depth of* 10 *inches. Timber: red*

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[*] With 64 meshes to the centimeter square.

[†] With 1600 meshes to the centimeter square.

and black-jack oaks. Geological formation: Quaternary brown loam table lands. Collected by R. H. Loughridge, 1884.

Dried soil contains friable clods of a grey-brown color. All passed through the coarse sieve except a very small quantity of small shot-iron ore. Its siliceous residue all passed through the fine sieve.

No. 2560—SUBSOIL *of the next preceding, taken to depth of* 6 *to* 14 *inches below the surface.* Collected by R. H. Loughridge, 1884.

Dried subsoil in friable clods of a brownish-buff color. All passed through the coarse sieve except a few particles of shot-iron ore. Its silicious residue all passed through the fine sieve.

No. 2561—VIRGIN SOIL. *Flatwood loam soil. Bandana post-office. Taken to the depth of* 10 *inches. Timber: red, post and white oaks, with some hickory, gum, persimmons, sycamore and hazel brush.* Collected by R. H. Loughridge, February 25th, 1884.

Dried soil with friable clods of a light-yellowish umber color. The coarse sieve separated from it some little shot-iron ore and a few small quartz pebbles All its silicious residue passed through the fine sieve.

No. 2562—SUBSOIL *of the next preceding, taken at from* 10 *to* 14 *inches below the surface.* Collected by R. H. Loughridge.

The dried subsoil is in moderately firm clods of a yellowish-grey color. All passed through the coarse sieve except very few particles of shot-iron ore. Its silicious residue all passed through the fine sieve.

No. 2563—VIRGIN SOIL. *Dark loam from Barlow. Taken to the depth of* 8 *inches. Timber: white oak, poplar, gum and sassafras. Geological formation: Quaternary brown loam lands.* Collected by R. H. Loughridge.

The dried soil mostly in powder with some small friable clods of a brownish-umber color. All passed through the coarse sieve except a little shot-iron ore. Its silicious residue all passed through the fine sieve.

No. 2564—SUBSOIL *of the next preceding, taken from* 8 *to* 10 *inches below the surface.* Collected by R. H. Loughridge.

The dried subsoil is in pretty firm small clods, of a dirty yellowish color. The coarse sieve removed from it only a little vegetable debris. All its silicious residue passed through the fine sieve.

No 2565—RED SANDY SOIL *of Sandy Ridge,* 3 *miles west of Ogden's store. Sample taken* 10 *inches deep. Timber: chiefly red oaks.* Collected by R. H. Loughridge.

Dried soil of a light snuff-brown color. No clods. All passed through the coarse sieve except a small quantity of shot-iron ore. The fine sieve removed from it 44.65 per cent. of fine sand in rounded grains.

No. 2566—VIRGIN DARK, BLUFF LOAM SOIL, *near mouth of Mayfield creek, at Steam Shovel. Taken* 8 *inches deep. Growth: poplar, white oak and hickory.* Collected by R. H. Loughridge.

Dried soil of a grey-brown color, containing but a few friable clods. Its silicious residue all passed through the fine sieve.

No. 2567—SUBSOIL *of the next preceding bluff loam, taken from* 8 *to* 12 *inches below the surface.*

The dried subsoil, of a brownish-buff color, is mostly in the form of small friable clods. All passed through the coarse sieve except a little vegetable debris. Silicious residue all passed through the fine sieve.

COMPOSITION OF THESE BALLARD COUNTY SOILS, ETC.

Calculated Dried at 212° F.

NUMBER IN REPORT.	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567
Organic and volatile matters.	3.306	5.772	4.635	3 096	2.079	3.642	2.114	3.510	2.364	1.961	3.733	1.281
Alumina and manganese oxide	2.945	6.876	4.217	3.065	4.613	4.639	4.523	3.906	4.602	1.907	2.180	3.268
Iron peroxide	1.860	4.124	1.915	1.907	2.478	2.363	3.077	2.112	2.870	1.403	1 519	2.224
Lime carbonate	.196	.210	1.463	.096	.071	.071	.046	.146	.086	.071	.349	.146
Magnesia	.181	.273	.267	.134	.202	.198	.344	.239	.222	.124	.175	.234
Phosphoric acid (P_2O_5) . .	.008	.226	.133	.062	.052	.108	.115	.100	.126	.094	.095	.078
Potash extracted by acids . .	.477	.723	.504	.420	.836	.295	.422	.419	.674	.250	.265	.109
Soda extracted by acids . .	.389	.145	not est.	not est.	not est.	.248	.136	.260	not est.	.286	.057	.023
Water expelled at 380-400° .	.556	1.263	.941	.571	.425	.842	.648	1.088	.698	.553	1.604	.958
Sand and insoluble silicates .	90.616	80.999	86 856	90.696	90.219	87.952	88.866	88 394	88.766	93 335	90.303	91.067
Totals	100.534	100.611	100.931	100.047	100.975	100.358	100 291	100.174	100.408	99 984	100.280	99.388
Hygroscopic moisture . . .	1.100	2.290	1.625	1.175	1.180	1.480	1.375	1.300	1.285	0.600	1.800	0.900
Potash in silicious residue . .	1.497	1.069	1.435	1.476	1.229	1.439	1.591	1.415	1.389	.907	1.859	2.081
Soda in silicious residue . .	.834	.277	1.243	not est.	1.082	1.208	1.551	.257	not est.	.567	1.025	.927
Sand	16.500	not est.	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	44.650	. . . .	. . . .

The virgin soil, No. 2557, of the Ohio river bottom, is the richest in essential elements of fertility of all these soils, and ought to be very productive under good culture, provided it is well drained. Its proportion of available potash, 0.773 per cent., is extraordinary. It is exceeded in this particular, however, by No. 2560, which has 0.836 per cent. All of these soils contain more than the usual average of potash, except this subsoil, No. 2567, which has only 0.109 per cent., which, other conditions being favorable, fits them for the cultivation of tobacco, hay or other green crops. Nos. 2559–60–1–2–4–5, are more or less deficient in lime, and Nos. 2556–9–60–5–6–7, also contain too little phosphoric acid, and would be benefited by top dressings of lime and of commercial phosphatic fertilizers. No. 2556 is especially deficient in phosphoric acid, while it contains the other essential elements in good or large proportions. It would require only phosphatic manures, such as ground-bone, superphosphate, guano, etc., to make it quite productive; provided drainage and other physical conditions are present. All of these soils are of fine texture; none contain coarse sand or gravel. They all have potash in more than average proportions, except No. 2567, which, indeed, contains what is generally considered a fair average quantity.

CLAYS OF BALLARD COUNTY.

No. 2568—SANDY CLAY. *Tertiary. Half a mile north-west of Blandville.* Collected by Jno. R. Procter.

Nearly white. Quite plastic. Contains no appreciable coarse sand. Infusible before the blow-pipe. Calcines white.

No. 2569—CLAY. *Three miles east of Blandville. A nearly white clay.* Collected by R. H. Loughridge.

Quite plastic. Contains no coarse sand. Of very difficult fusion before blow-pipe. Calcines white.

No. 2570—CLAY. *North side of west fork of Mayfield creek, 4 miles north-east of Milburn.* Collected by R. H. Loughridge.

Of a very light buff-grey color. Quite plastic. Contains no coarse sand. Infusible before the blow-pipe. Calcines light-grey.

No. 2571—CLAY. *Two miles north of Wickliffe.* Collected by R. H. Loughridge.

Nearly white. Contains much fine white opaque sand. Quite plastic. Infusible before the blow-pipe. Calcines white.

No. 2572—YELLOW OCHREOUS CLAY. *Wickliffe, Ballard county.* Collected by R. H. Loughridge.

Of a handsome yellow ochre color. Washed in water it left a very small proportion of very fine sand. Before the blow-pipe it fuses into a blackish slag or glass. Calcines of a handsome red color.

No. 2573—FIRE-CLAY. *Wickliffe, Ballard county.* Collected by R. H. Loughridge.

Of a dark-grey color when dried. Contains fine sand, brownish, mixed with a few small specks of mica. Before the blow-pipe, of very difficult fusion. Calcines white.

COMPOSITION OF THESE BALLARD COUNTY CLAYS.

Air Dried.

NUMBER IN REPORT.	2568	2569	2570	2571	2572	2573
Silica	74.840	71 180	76 540	63.840	44.840	73.240
Alumina . . .	16 580	20.800	14.820	26.040	22.830	15.760
Iron peroxide .	1.400	1.780	.960	.740	20.350	1.920
Lime	.269	trace.	trace.	trace.	.101	.325
Magnesia . . .	.209	.101	.381	.137	.188	519
Potash	1.293	.247	.926	.714	not est.	1.467
Soda	283	.291	.229	.207	not est.	.147
Water, etc. . .	5.126	5 601	6.194	8.322	11.741	6.622
Totals . . .	100.000	100.000	100.000	100.000	100.000	100.000
Sand	not est.	not est.	not est.	44.000	not est.	53.490

All of these Ballard county clays are quite refractory except the ochreous clays or yellow ochre, and could be used as fire-clay in its various applications. They all contain considerable proportions of fine sand. Some of them, having similar composition with the celebrated German glass pot clays, deserve a trial for this use. The ochreous clay, No. 2572, could be used, after washing to remove sand, as a cheap pigment, either in its natural condition or after calcination.

No. 2574—**GREEN SAND.** *Bluff at Caledonia opposite to Ballard county. Tertiary.* Collected by R. H. Loughridge.

A dark-colored, nearly black, friable material. Powder of dark greenish-grey color.

COMPOSITION. (Air Dried.)

Silica	59.940
Alumina	13.370
Iron peroxide	10.210
Lime	.549
Magnesia	2.010
Potash	3 243
Soda	.078
Phosphoric acid	a trace.
Water	10.600
	100.000

This contains less potash than is usually found in Glauconite (green sand), but it has, probably, been somewhat altered by weathering.

BATH COUNTY.

IRON ORES.

No. 2575—IRON ORE *from Carnel Rice's, property of Captain W. G. Allen. Clinton group of Upper Silurian formation.* Collected by W. M. Linney, June, 1885.

Ore of a yellowish-brown color of the usual structure of the Clinton iron ore.

No. 2576—IRON ORE *from the Purvis lands in Bath county. Clinton group.* Collected by W. M. Linney, June, 1885.

Resembles the preceding, but is reddish in color.

No. 2577—IRON ORE. *Average sample from the lands of Wm. Warren, near head of Rose Run, Bath county. Clinton Group.* Collected by W. M. Linney, June 1st, 1885.

Ore of the structure of Clinton ore, of a reddish-brown color.

COMPOSITION OF THESE BATH COUNTY CLINTON IRON ORES.

(Air Dried.)

Number in Report.	2575	2576	2577
Iron peroxide	47.630	51.430	58.570
Alumina	5.468	5.182	3.720
Lime carbonate	16.560	13.080	15.160
Magnesia carbonate	9.974	9.444	4.528
Phosphoric acid (P_2O_5)	1.202	1.138	1.010
Silica	7.160	7.800	6.960
Water, expelled at 212° F.	1.143	.698	1.607
Carbonic acid, water, etc.	10.863	11.288	8.445
Totals	100.000	100.000	100.000
Percentage of iron	33.341	36.001	40.999

Although the iron in the analysis is estimated as peroxide, some of it, in all these ores, is in the form of ferrous carbonate. They also contain a little organic matter not estimated.

These ores have considerable proportions of lime and magnesia, which will aid in fluxing them, and a notable quantity of phosphoric acid, which will not prevent their profitable use in the production of merchantable iron.

BELL COUNTY.

COALS.

No. 2578—COAL. *Browning's cannel coal. Three miles above Pineville, on Cumberland river; 275 feet above drainage.* Collected by R. C. B. Thruston. A 23-inch layer.

A pure-looking cannel coal. Fracture large, irregular conchoidal. Bird's-eye fracture in parts. Some shining pyrites, but no fibrous coal apparent.

No. 2579—COAL. *Myers' bank. Low Branch of Yellow creek.* Collected by R. C. B. Thruston. Sample from the 12-inch, 16-inch and 15-inch layers of the bed.

Generally pitch-black, breaking irregularly cuboidal with shining surfaces. Some fibrous coal and pyrites in some of the pieces.

No. 2580—COAL. *Caney Branch of Yellow creek.* Collected by R. C. B. Thruston. Sample from the 20-inch and 8-inch layers of the bed.

Generally pitch-black, breaking irregularly, partly cuboidal, with shining surfaces. No fibrous coal or pyrites apparent in the sample.

No. 2581—COAL. *James Barnett's. Clear Fork of Yellow creek of Cumberland river. Average sample of the coal tested for coking.* Collected by R. C. B. Thruston.

A pure-looking sample, generally of what seems to be bituminous, with some little splint-coal.

No. 2582—COAL. *F. R. Barner's. Yellow creek. Average sample from the barrel-full tested for coking.* Collected by R. C. B. Thruston.

No. 2583—COAL. *Myers'. Yellow creek. Average sample from the barrel-full tested for coking.* Collected by R. C. B. Thruston.

No. 2584—COAL. *Alf. McTee's. Yellow creek of Cumberland river. Average sample from the coal tested for coking.* Collected by R. C. B. Thruston.

No. 2585—COAL. *Dean seam; lower 36 inches of the bed. Greasy creek of Cumberland river. Average sample of the coal collected for coking* by R. C. B. Thruston.

No. 2586—COAL. *Dean's seam. Average sample collected for coking two years ago* by R. C. B. Thruston.

No. 2587—COAL. *W. D. King's. Yellow creek, Cumberland river. Average sample collected for coking* by R. C. B. Thruston.

No. 2588—COAL. *Dorton Coal Bank, half a mile above the mouth of Straight creek, near Pineville. Bed 32 inches thick.* Collected by R. C. B. Thruston.

A bright, pitch-black coal. Structure imperfectly laminated; fracture generally cuboidal. Very little fibrous coal and no pyrites apparent.

COMPOSITION OF THESE BELL COUNTY COALS.

(Air Dried.)

Number in the Report.	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588
Hygroscopic moisture	0.86	1.00	0.88	0.80	1.20	1.16	1.40	2.00	1.50	0.92	2.20
Volatile combustible matters	41.54	34 90	37.72	33 94	37.90	36.84	38.60	35.20	32.90	36.08	33.94
Coke	57.60	64.10	61.40	65.26	60.90	62.00	60.00	62.80	65.60	63.00	63.86
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100 00
Total volatile matters	42.40	35.90	38.60	34.74	39.10	38.00	40.00	37.20	34.40	37.00	36.14
Fixed carbon in the coke	50 60	55.70	57.40	58.86	57.78	57.50	57.30	58.80	60.00	58.00	62.06
Ash	7.00	8.40	4.00	6 40	3.12	4.50	2.70	4.00	5.60	5.00	1.80
Percentage of sulphur	5.078	1.829	1.783	1.898	1.080	1.585	0.629	0.687	0.692	1.348	0.491
Character of the coke	light spongy.	light spongy.	light spongy.	light spongy.	light spongy.	spongy.	light spongy.	dense spongy.	light spongy.	spongy.	light spongy.
Color of the ash	grey brown.	grey purple.	lt.grey brown.	lt. purple grey.	dark-grey.	light grey.	light brown.	light brown.	whitish.	lt. grey brown.	lt.brown grey.

Coal No. 2578 is remarkable as being a coking cannel coal. It also contains an exceptional proportion of sulphur, viz.: 5.078 per cent. This, however, may have been an accident of the sampling. This coal and No. 2579 are the only ones of the lot which give an ash percentage above a good average, viz.: 7.00 and 8.40 per cent. severally. All the other coals leave only a moderate or small proportion of ash; No. 2588 giving only 1.80 per cent.

They are all good coals, most of them very good coking coals, as is shown in the results quoted further on.

BELL COUNTY COKES.

No. 2589—COKE. *Forty-two-hours coke, made at Birmingham, Ala., by G. D. Fitzhugh, Esq., from coal taken from the bank of Mr Frederick Barner, on Yellow creek*, Bell county, Ky. (see No. 2582), December, 1885.

No. 2590—COKE (No. 3*a*). *F. R. Barner's, Yellow creek, Bell county Ky. Forty-two-hours coke, made at Quinnimont, West Virginia*, March 22-25, 1886. R. C. B. Thruston.

No. 2591—COKE (No. 3). *F. R. Barner's, Yellow creek, Bell county. Seventy two-hours coke, made at Quinnimont, West Virginia.* R. C. B. Thruston.

No. 2592—COKE. *Forty-two-hours coke, made at Birmingham, Alabama, by G. H. Fitzhugh, from coal taken from bank of James Barnett, on Clear creek, fork of Yellow creek*, Bell county, Ky., December, 1885. R. C. B. Thruston. (See No. 2581 for the coal.)

No. 2593—COKE (No. 6). *James Barnett's, Clear Fork of Yellow creek, Bell county, Ky. Forty-eight-hours coke, made at Quinnimont, West Virginia.* R. C. B. Thruston.

No. 2594—COKE (No. 6). *James Barnett's, Clear Fork of Yellow creek, Bell county, Ky. Seventy-two-hours coke, made at Quinnimont, West Virginia*, March 20-23, 1886. R. C. B. Thruston.

No. 2595—COKE (No. 6). *James Barnett's, of Clear Fork of Yellow creek, Bell county, Ky. Forty-eight-hours coke, made at Quinnimont, West Virginia.* R. C. B. Thruston.

No. 2596—COKE. *Forty-two-hours coke, made at Birmingham, Alabama, by G. D. Fitzhugh, from coal taken from the bank of James M. Myers, on Yellow creek, Bell county, Ky.*, December, 1885. R. C. B. Thruston.

No. 2597—COKE (No. 4). *James Myers, Yellow* [illegible], *B* [illegible] *county, Ky.* Seventy-two-hours coke, made at Quinnimont, West Virginia, March 20-23, 1886. R. C. B. Thruston.

No. 2598—COKE (No. 4*a*). *James Myers, Yellow creek, Bell county, Ky. Forty-eight-hours coke, made at Quinnimont, West Virginia*, March 20-23, 1886. R. C. B. Thruston.

COMPOSITION OF THESE BELL COUNTY COKES.
(Air Dried.)

Number in Report.	2589	2590	2591	2592	2593	2594	2595	6	2597	2598
Moist. expel'd at red heat	0 80	0.20	0.50	1.80	0.60	0.40	1.30	2.40	0.40	0.10
Carbon in the coke	93.90	95.80	94.50	87.20	87.80	89.20	88.90	85.30	90.80	91.50
Ash	5.30	4.00	5.00	11.00	11.60	10.40	9.80	12.30	8 80	8 40
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	1.480	1.710	0.959	1.843	1.590	1.590	1.346	1.548	0 547	0.794
Color of the ash	dark brown.	dark brown.	dark brown.	light brown.	reddish brown.	greyish brown.	brownish grey.	chocolate brown.	light grey brown.	light grey brown.
Hours of coking	42	48	72	42	48	72	48	42	72	48
Owner of the coal	Frederick Barner.			James Barnett.				James Myers.		

BELL COUNTY COKES—Continued.

No. 2599—COKE. *Forty-two-hours coke, made at Birmingham, Alabama*, by G. D. Fitzhugh, from coal taken from the bank of Daniel Howard, on Left-hand Fork of Straight creek, Bell county, Ky., December, 1885. R. C. B. Thruston.

No. 2600—COKE. *Forty-two-hours coke, made at Birmingham, Alabama*, by G. D. Fitzhugh, from coal obtained from bank of Mr. Alf. McTee, on Yellow creek, Bell county, Ky., December, 1885. (The sample of coal from which this coke was made had some earthy matter mechanically mixed.)

No. 2601—COKE (No. 5). *McTee, Bell county, Ky.* (The smaller sample.)

No. 2602—COKE (No. 5). *Alf. McTee, Yellow creek, Bell county, Ky.* Seventy-two-hours coke, made at Quinnimont, West Virginia, March 20-23, 1886. R. C. B. Thruston.

No. 2603—COKE. *Forty-two-hours coke, made at Birmingham, Alabama*, by G. D. Fitzhugh, from coal taken from bank of W. D. King, near Yellow creek, Bell county, Ky., December, 1885. R. C. B. Thruston.

No. 2604—COKE (No. 7). *W. D. King, Yellow creek, Bell County, Ky.* Forty-eight-hours coke, made at Quinnimont, West Virginia, March 22-24, 1886. R. C. B. Thruston.

No. 2605—COKE (No. 7). *W. D. King, Yellow creek, Bell county, Ky.* Seventy-two-hours coke, made at Quinnimont, West Virginia, March 20-23, 1886. R. C. B. Thruston.

No. 2606—COKE. *Forty-two hours, made at Birmingham, Alabama*, by G. D. Fitzhugh, from coal taken from bank of Moses Dorton, at mouth of Straight creek, near Pineville, Bell county, Ky., December, 1885. R. C. B. Thruston.

No. 2607—COKE (No. 16). *Seventy-two-hours coke; upper bench of Dean seam*, made at Quinnimont, West Virginia, March 20-23, 1886. Bell and Knox counties, Ky. R. C. B. Thruston.

No. 2608—COKE (No. 13).* *Of lower bench of Dean bank, Still-house Branch of Greasy creek, Bell county, Ky.* Seventy-two hours coke, made at Quinnimont, West Virginia, March 20-23, 1886. R. C. B. Thruston.

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* These numbers in parentheses were attached to the samples by Mr. Thruston.

COMPOSITION OF BELL COUNTY COKES—Continued.

(Air Dried.)

Number in Report.	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608
Moist. expel'd at red heat.	0.20	1.60	0 70	0.40	0.26	0.66	0.20	1.00	0.90	1.80
Carbon in the coke . . .	94.20	89 60	92.70	94.00	92.94	90.54	92.20	92.80	92.70	90.50
Ash	5.60	8.80	6.60	5.60	6.80	8.80	7 60	6.20	6.40	7.70
Totals	100.00	100.00	105.00	100.00	100.00	100.00	100.00	100.00	100 00	100.00
• Percentage of sulphur . .	0 601	0.491	0.450	0.629	1.083	1.150	0.491	0.603	1.975	0 684
Color of the ash . . .	brown.	light brown.	brownish grey.	brownish grey.	light brown.	lt. reddish brown.	brown grey.	light brown	nearly white.	lt. brownish-grey.
Hours of coking	42	42	?	72	42	48	72	42	72	72
Owner of the coal . .	Daniel Howard.	Alf. McTee.			W. D. King.			Moses Dorton.	Dean Seam. Up'r b'nch.	Lw'r b'nch.

These Bell county cokes are generally good, and some of them are very good.

The percentage of carbon in them varies from 95.80 per cent. in No. 2590, to 85.30 per cent. in No. 2596.

The percentage of ash in them varies from 4.00 per cent. in No 2590, to 12.30 per cent. in No. 2596.

The percentage of sulphur in them varies from 0.450 per cent. in No. 2601, to 1.975 per cent. in No. 2607.

BOYLE COUNTY.

No. 2609—LIMESTONE *from quarry of H. Olmstead, near Danville, Boyle county.* Sent by Mr. Procter, June 16, 1885. Will it make good lime?

A dull-looking, dark-grey, fine granular lime-rock, containing fragments of fossils.

COMPOSITION.—Air Dried.

Carbonate of lime	82.840	equal to 46.89 per cent. of lime
Carbonate of magnesia	3.511	
Alumina and iron peroxide	3.861	
Phosphoric acid (P_2O_5)	819	
Siliceous residue	5.620	
Moisture, organic matter, loss, etc.	3.349	
	100.000	

It would calcine into good lime fit for all ordinary uses in building, etc., and the phosphoric acid it contains would add to its value, when applied to poor soils as a top-dressing.

BREATHITT COUNTY.

COALS.

No. 2610—COAL. *Eighty-eight inches. Wolf creek, Breathitt county.* Collected by J. M. Hodge.

A weathered sample of splint coal.

No. 2611—COAL. *Fifty-nine inches. Berry Turner's. Long's creek, Breathitt county. Sample from the lower thirty inches.* Collected by J. M. Hodge.

A pure-looking, pitch-black coal; fracture irregular with shining surfaces. No pyrites apparent, and very little fibrous coal.

No. 2612—Coal. *Gouch & Co.; John Little's Branch, North Fork of Kentucky river, Breathitt county. Middle of the 46-inch seam.* Collected by J. M. Hodge.

A weathered sample of what appears to be a splint coal.

No. 2613—Coal. *Forty-two inches; splint and bituminous. Green Taulbee's.* Collected by J. M. Hodge.

A weathered sample.

No. 2614—Coal. *Sixty inches. L. H. Nobles, Leatherwood Branch of Lost creek, Breathitt county.* Collected by J. M. Hodge.

A much weathered sample of what seems to be a splint coal.

No. 2615—Coal. *Forty-three inches. Head of Leatherwood Branch of Lost creek.* Collected by J. M. Hodge.

A pure-looking, pitch-black coal. No pyrites apparent, and but little fibrous coal.

No. 2616—Coal. *Bituminous coal,* 33 *inches; cannel coal,* 9 *inches.* Collected by J. M. Hodge.

A weathered sample of the lower 27 inches of the bituminous coal.

No. 2617—Coal. *Sample of the cannel coal of the next preceding.* Collected by J. M. Hodge.

A much weathered sample.

No. 2618—Coal. *Gouch & Co.; John Little Branch, North Fork of Kentucky river. Bituminous coal,* 35 *inches; cannel coal,* 11 *inches.* Breathitt county. Selected sample of the cannel coal. Collected by J. M. Hodge.

No. 2619—Cannel Coal. *Picked sample. Crawford's. Beginning Branch of Middle Fork of Kentucky river.* Breathitt county. Collected by J. M. Hodge.

COMPOSITION OF THESE BREATHITT COUNTY COALS.

(Air Dried.)

Number in Report.	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619
Specific gravity	1.351	1.275	1.410	1.310	not est.	1.384	not est.	not est.	1.177	1.274
Hygroscopic moisture .	2.80	2.00	7.40	3.80	9.60	2.80	3.30	0.80	1.20	1.00
Volatile combustible mat.	33.60	35.36	30.20	34.40	29.46	31.16	32.80	41.70	53.80	41.10
Coke	63.60	62.64	62.40	61.80	60.94	66.04	63.90	57.50	45.00	57.90
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters . .	36.40	37.36	37.60	38.20	39.06	33.96	36.10	42.50	55.00	42.10
Fixed carbon in the coke.	54.20	57.36	52.04	51.80	44.14	53.34	48.80	33.30	39.46	46.70
Ash	9.40	5.28	10.36	10.00	16.80	12.70	15.10	24.20	5.54	11.20
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur . .	0.695	1.019	0 621	0.585	0.478	0.690	0.840	0 952	0.722	1.120
Character of the coke .	dense	light spongy.	pulverulent.	dense.	pulverulent.	dense.	pulverulent.	pulverulent.	dense.	dense.
Color of the ash . . .	brownish grey.	white.	very light salmon.	grey brown.	lt. brownish-grey.	lt. brownish-grey.	light reddish.	light pink.	lt. brick colored.	dark grey.

The *cannel* coals, Nos. 2617, 2618 and 2619 are distinguished by their large proportions of volatile combustible matters—41.70, 53.80 and 41.10 per cent. severally. The best of these, No. 2618, leaves only 5.54 per cent. of ash, and is quite a pure good cannel coal. The two others, containing 24.20 and 11.20 per cent. of ash material, are proportionately less valuable. The ash percentage in all these coals, except Nos. 2611 and 2618, is above the average of good coals, varying from 9.40 per cent. in No. 2610, and 10. per cent. in No. 2613, up to 24.20 per cent. in No. 2617.

The much weathered samples, Nos. 2612 and 2614, show very large proportions of hygroscopic moisture. Other weathered samples contain it in from 2.00 to 3.80 per cent. In these cases, the coal further in the bed, where it has not been exposed to the atmospheric agencies, would probably contain very much less moisture.

BUTLER COUNTY.

No. 2620—MINERAL WATER, *from Sunny Lane Spring, near Mr. L. B. Orange's, Sunny Lane, Butler county.* Collected by C. C. Cohron, M. D., October, 1885

COMPOSITION IN 1000 PARTS OF THE WATER.

Carbonate of iron	0.1315	Held in solution by carbonic acid.
Carbonate of lime	.0147	
Carbonate of magnesia	.0110	
Carbonate of soda	.0251	
Sulphate of lime	.0255	
Sulphate of potash	.0108	
Chloride of sodium	.0100	
Silica	.0264	
Total saline matters in 1000 of the water	0.2545	

It appears to be a good saline chalybeate water.

CALLOWAY COUNTY.

SOILS, ETC.

No. 2621—VIRGIN SOIL *of Clark's river bottom. Taken* 10 *inches deep.* Murray, Calloway county. Collected by R. H. Loughridge.

Dried soil in moderately firm clods of a dirty brown-grey color. It all passed through the coarse sieve.* Its siliceous residue left a little sand on the fine sieve.†

No. 2622—VIRGIN SOIL *of the first bottom of Tennessee river. W. E. Brown's place, south of Shannon creek. Sample taken to the depth of twelve inches. Growth: white, red, and water oaks, sweet gum, scaly-bark hickory, some poplar, sassafras, ash, papaw, spicewood and redbud.* Collected by R. H. Loughridge.

Dried soil of grey-brown color. Clods firm. All passed through the coarse sieve except a very small quantity of shot-iron ore. Its silicious residue, from digestion in acids, all passed through the fine sieve, except a very small quantity of fine quartz sand.

No. 2623—VIRGIN SOIL *of the Big Barrens,* 10 *miles northwest of Murray, Calloway county. Sample taken to the depth of* 6 *inches. Timber: red, post, black-jack and white oaks and hickory, all small.* Collected by R. H. Loughridge, 1885.

Dried soil of a grey-brown color. Clods friable. All passed through the coarse sieve, except a small quantity of small shot-iron ore and vegetable debris. Its silicious residue all passed through the fine sieve, except a small quantity of fine white sand.

No. 2624—SUBSOIL *of the next preceding, taken from* 6 *to* 10 *inches deep.* Collected by R. H. Loughridge, 1885.

Dried subsoil of a lighter and more reddish grey-brown color than the preceding. Clods rather firm. All passed through the coarse sieve, except a small quantity of shot-iron ore and vegetable debris. Its silicious residue all passed through the fine sieve, except a small quantity of fine white sand.

No. 2625—VIRGIN SOIL OF UPLAND, 1 *mile north of New Providence, Calloway county. Taken to the depth of* 8 *inches. Timber: red and post oaks and hickory.* Collected by R. H. Loughridge.

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* Coarse sieve has 64 meshes to the centimeter square.

† Fine sieve has 1600 meshes to the centimeter square.

Dried soil of a light-grey-brown color. Clods friable. All passed through the coarse sieve, except a small quantity of vegetable debris and small shot-iron ore. Its silicious residue all passed through the fine sieve.

No. 2626—SUBSOIL *of the next preceding, taken* 8 *to* 12 *inches deep.* Collected by R. H. Loughridge.

Dried soil of a lighter color and more reddish than the preceding; clods more firm. All passed through the coarse sieve except a small quantity of vegetable debris. Its silicious residue all passed through the fine sieve.

No. 2627—VIRGIN SOIL *of the second bottom of Tennessee river; W. E. Brown's place, south of Shannon creek, Calloway county. Taken to the depth of* 6 *inches. Growth: Spanish, red and white oaks, poplar, gum, chestnut and black locust.* Collected by R. H. Loughridge, 1885.

Dried soil of a dark grey-brown color. Clods friable. All passed through the coarse sieve except a small quantity of vegetable debris and small shot-iron ore.

No. 2628—SUBSOIL *of the next preceding, taken to depth of* 6 *to* 12 *inches.* Collected by R. H. Loughridge.

Dried soil of a light reddish-grey-brown color. Clods friable. All passed through the coarse sieve except a small quantity of vegetable debris. Its silicious residue all passed through the fine sieve, except a small quantity of fine white sand and a few small specks of mica.

No. 2629—VIRGIN UPLAND SOIL, 5 *miles east of Murray, Calloway county. Taken to the depth of* 10 *inches. The soil is dark for one inch, and then a light-brown loam to the subsoil. Growth: red oak chiefly, some post oak and hickory.* Collected by R. H. Loughridge.

Dried soil of a light yellowish-grey-brown color. Clods somewhat firm. All passed through the coarse sieve except a small quantity of vegetable debris and fine shot-iron ore. Its silicious residue all passed through the fine sieve except a small quantity of fine sand.

No 2630—VIRGIN SOIL. *Upland sandy loam of the "Coalings" of the south-east corner of Calloway county Taken to the depth of 6 inches. Original growth: red, black Spanish and post oaks and hickory.* Collected by R. H. Loughridge.

Dried soil of a dirty brownish-buff color. Clods quite friable. All passed through the coarse sieve except a little small shot-iron ore. Its silicious residue all passed through the fine sieve except 2.8 per cent. of fine white quartz sand.

No. 2631—SUBSOIL *of the next preceding. Sample from depth between 6 and 12 inches.* Collected by R. H. Loughridge.

Dried subsoil of a brownish-yellow color. Clods moderately firm. All passed through the coarse sieve except a small quantity of small shot-iron ore. Its silicious residue all passed through the fine sieve except 2.5 per cent. of fine quartz sand.

No. 2632—VIRGIN SOIL *of Post Oak Flatwoods, 2 miles east of the Murray and Paris road, near the Tennessee State line. Sample taken to the depth of 6 inches. Timber: post and red oaks.* Collected by R. H. Loughridge.

Dried soil of a dirty grey-buff color. Clods friable. All passed through the coarse sieve except a small quantity of fine shot-iron ore. Its silicious residue left 5.8 per cent. of fine white sand on the fine sieve.

No. 2633—SUBSOIL *of the next preceding. Sample from depth between 6 and 12 inches.* Collected by R. H. Loughridge.

Dried subsoil of a light-yellowish-grey color. Clods somewhat firmer than of the preceding. Coarse sieve removed from it only a small quantity of small shot-iron ore. Fine sieve separated 5.05 per cent. of fine white sand from its silicious residue.

No. 2634—VIRGIN BOTTOM SOIL *of Shannon creek. Taken to the depth of 6 inches. A dark-blackish loam. Growth: white and red oaks, poplar and some walnut.* Collected by R. H. Loughridge.

The coarse sieve separated a considerable quantity of shot-iron ore. Fine sieve removed 2.05 per cent. of fine sand from silicious residue.

No. 2635—SUBSOIL *of next preceding. Taken at depth of* 6 *to* 12 *inches. A stiff yellowish clay.* Collected by R. H. Loughridge.

Dried subsoil of a light-grey yellow color. Clods quite firm. Coarse sieve removed a small quantity of shot-iron ore. Fine sieve separated 2.2 per cent. of fine white sand.

COMPOSITION OF THESE CALLOWAY COUNTY SOILS AND SUBSOILS.

(Calculated Dried at 212° F.)

Number in Report.	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635
Organic and volatile matters	3.475	6.080	3.540	2.632	2.862	2.569	5.482	2 627	3.000	2.497	2.999	2.650	2.188	5.848	3.500
Alumina and manganese oxide	3.612	8 171	3.190	5 239	3.321	4.920	3 595	5.333	4.395	1.924	4.785	1.989	2.809	4 982	4.332
Iron peroxide	2.116	4.791	2 862	4.234	2.968	4.145	3.060	4.365	3.711	2.020	4.250	2.564	2.836	2.455	5.575
Lime carbonate	.021	.280	.096	.096	trace.	.046	.147	.220	.146	.131	.041	.652	.096	.163	.132
Magnesia	.180	.461	.125	.107	.234	215	.245	.180	.217	.118	.273	.089	.153	.378	.364
Phosphoric acid (P_2O_5)	.062	.218	.093	.084	.062	.062	.124	.124	.094	.094	.094	.076	.094	.249	.159
Potash extracted by acids	.310	.461	.084	.389	.369	.151	.246	.517	.238	.035	.256	.068	.127	.259	.604
Soda extracted by acids	not est.	not est.	.119	not est.	not est.	.097	not est.	not est.	.029	not est.	not est.	not est.	not est.	not est.	not est.
Water expelled at 380° F.	1.100	2.135	1.060	.860	.824	.755	1.401	.859	.834	.453	.629	.657	.522	1.323	.814
Sand and insoluble silicates	88.432	77.719	88.883	86.106	89.353	86.342	84.792	86.200	88.122	92.631	86.528	91.345	90.900	84.356	84.426
Totals	99.308	100.316	100.052	99.747	99.993	99.302	99.092	100.425	100.786	99.903	99.769	100.090	99.815	100.013	99 906
Hygroscopic moisture	1.450	2.650	1.150	1.250	0.950	1.125	1.500	1.050	1.100	0.875	1.650	1.150	1.300	1.850	1.700
Potash in silicious residue	1.146	1.487	1.572	1.378	1.245	1 264	1.469	1.360	1.307	1.605	1.866	1.090	1 093	1.268	1.380
Soda in silicious residue	0.535	253	.331	.792	.374	.339	.267	.694	.411	.424	.274	.455	.439	.309	.588

The alluvial river bottom soils, Nos. 2621, 2622, 2627, 2628, 2634 and 2635, with the single exception of No. 2621, from Clark's river bottom, have the composition of good fertile soils, containing all the essential elements and organic matters in more than average proportions, and with good culture and sufficient drainage ought to be quite productive. No. 2621 is quite deficient in lime and phosphoric acid, and would, doubtless, respond favorably to applications of super-phosphates or other fertilizers containing these essential ingredients.

Lime is apparently quite deficient, not only in this but in soils Nos. 2625, 2626 and 2631, and is below a good average in Nos. 2623, 2624 and 2633. Top-dressings of slacked lime or ground limestone would, no doubt, be profitable to all these soils. Phosphoric acid is very deficient in soils Nos. 2621, 2625 and 2626, and in proportions below a good average in Nos. 2623, 2624, 2629, 2630, 2631 and 2632. Potash is very deficient in Nos. 2630 and 2632, and below a good average proportion in No. 2623. No. 2630 appears, by its chemical composition, to be the poorest of all these soils; but this, as well as all the others, if well drained and properly cultivated, with the use of suitable manures or fertilizers, may be made to produce good crops.

SANDS OF CALLOWAY COUNTY.

No. 2636—FINE MICACEOUS SAND, *slightly calcareous. Cretaceous formation, 2 miles north-east of New Concord.* Collected by R. H. Loughridge.

A very fine-grained white sand, containing minute specks of mica. All passed through the coarse sieve. Its silicious residue, from digestion in acids, all passed through the fine sieve except 4.45 per cent. of fine white quartz grains with small specks of mica.

No. 2637—SAND *apparently similar to preceding, but slightly colored brownish with iron peroxide.* Collected by R. H. Loughridge.

All passed through the coarse sieve. The fine sieve separated from its silicious residue only 6.75 per cent. of small quartz grains with mica scales.

COMPOSITION OF THESE CALLOWAY COUNTY SANDS.

(Calculated Dried at 212° F.)

Number in Report.	2636	2637
Organic and volatile matters	1.815	0.690
Alumina, iron peroxide and P_2O_5	.605	.505
Lime carbonate	.090	.095
Magnesia	.282	trace.
Potash removed by acids	.044	not est.
Soda removed by acids	not est.	not est.
Water expelled at 380° F.	. . . . .	. . . . .
Sand and insoluble silicates	97.395	98.145
Total	100.181	99.485
Hygroscopic moisture	0.075	0.025
Total potash	0.514	0.289

These sands might be useful in glass-making or to mix with tough clays for pottery, etc.

CALLOWAY COUNTY.

CLAYS, ETC.

No. 2638—CLAY. *Siliceous earth (or decomposed chert) from Brandon's Mill. Lower Carboniferous siliceous group. Calloway county.* Collected by R. H. Loughridge.

A very fine-grained, friable, white mass, containing small pieces of undecomposed chert. Powder harsh to the feel.

No. 2639—CLAY. *Tertiary, half a mile south of Wyatt's school-house, north-west part of Calloway county.* Collected by R. H. Loughridge, June 17, 1885.

A white clay. Powder feels soft. Contains about 21 per cent. of fine white sand.

No. 2640—WHITE PIPE-CLAY. *Below Quaternary gravel. R. Morris', east of New Providence.* Used for pottery. Collected by R. H. Loughridge.

Color, light-buff-grey, with some darker streaks. Powder soft, contains a small proportion of very fine sand.

No. 2641—BLACK PYRITOUS PLASTIC CLAY. *Tertiary; below the white pipe-clay. R. Morris', east of New Providence.*

Indurated, imperfectly laminated, fine-grained. Powder soft. Light slate color. Contains a few small grains of pyrites.

No. 2642—**Black Joint-clay** *or so called soapstone. Lignitic Tertiary.* Murray, Calloway county. Collected by R. H. Loughridge.

Fine-grained, indurated clay, showing minute specks of mica. Tough. Fracture irregular, with imperfect lamination. Said not to glaze in pottery. Washed out 39.78 per cent. of light-brown, fine sand, containing a few small mica scales.

No. 2643—**Clay** *from Russell's Pottery,* 6 *miles east of Murray.* Collected by R. H. Loughridge.

Nearly white, with a few small brownish ochreous veins.

No. 2644—**Dark Clay.** (*Bluish when wet.*) *Mahan's,* 6 *miles east of Murray.* Collected by R. H. Loughridge.

Color, purplish-slate-grey. Contains minute mica scales, and about 39 per cent. of fine white sand, with minute mica scales.

No. 2645—**Black Plastic Clay** *underlying white clay at Rufus Morris', east of New Providence. Tertiary.* Collected by R. H. Loughridge.

Resembles the next preceding. Imperfectly laminated.

No. 2646—**Yellow Clay** *or ochre. Wadesboro.* Collected by R. H. Loughridge.

Of a handsome yellow ochre color. Calcines of a handsome red color. Fuses before the blow-pipe. Resembles No. 2572, of Ballard county (which see). Laminated. Laminæ varying in depth of tint.

COMPOSITION OF THESE CALLOWAY COUNTY CLAYS.

(Air Dried.)

Number in Report.	2638	2639	2640	2641	2642	2643	2644	2645
Silica	87.300	46.020	61.680	56.680	66.380	57.840	54.140	57.400
Alumina	10.480	38.980	28.500	29.700	16.480	30.840	32.140	29.440
Iron peroxide			1.680	1.480	3.500	1.180	1.040	1.340
Lime	.045	.773	.101	trace.	.213	.011	.011	.134
Magnesia	.281	.136	.136	.281	.497	.050	.032	.245
Potash	.888	.809	1.158	1.004	.928	.618	.965	.522
Soda	.209	.172	.822	.274	.228	.519	.468	.437
Water, etc.	.797	13.610	5.923	10.581	11.774	9.442	11.204	10.482
Totals	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
Sand	not est.	21.000	not est.	not est.	39.780	not est.	39.000	not est.

The decomposed chert No. 2638, is mainly very fine and pure siliceous sand. It would serve well to mix with tough clay to reduce its shrinkage, etc. It might answer to make what are called Bath bricks, used for scouring purposes or polishing, and possibly could be used as an ingredient of white glass.

These are mostly good refractory clays. Those which contain the least of fluxing materials, such as iron oxide, lime, potash, soda or magnesia, are the most refractory, and would make good fire-brick or linings for furnaces, etc. Many of them would make good white pottery ware or terra-cotta.

No good reason appears from the analysis why No. 2642 should not glaze,* as, on testing it for sulphate of lime, very little was found in its composition.

The least refractory of these clays is, undoubtedly, No. 2642, which contains 3.500 per cent. of iron peroxide; 0.928 per cent. of potash, etc. The large proportions of these fluxing materials is, however, partly neutralized by its large proportion of silica.

The ochreous clay—yellow ochre—might be used as a cheap pigment, either raw or calcined. (See remarks on Ballard county clays, etc.)

CLAY COUNTY.

COALS.

No. 2647—COAL. *Fifty-one inches. Isaac Jackson's, left Fork of Goose creek, Clay county.* Collected by G. M. Hodge, December, 1885.

A pure-looking coal. No apparent pyrites and but little fibrous coal. Ferruginous stains on some of the pieces.

No. 2648—COAL. *Thirty-one inches. T. T. Garrard's mine, east side of Goose creek, at its forks. Sample from 200 feet under.* Collected by G. M. Hodge, December, 1885.

A pure-looking, pitch-black coal, with very little fibrous coal and only a few specks of pyrites.

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* With common salt alone.

No. 2649—COAL. *Thirty-nine inches. Mrs. S. A. White's, Salt Works mine. Sample from twenty feet under.* Collected by G. M. Hodge.

Resembles the preceding. No pyrites apparent.

No. 2650—COAL. *Forty-five inches. G. L. Hornsby's, Laurel creek, Clay county.* Collected by G. M. Hodge.

Apparently a good splint coal. No apparent pyrites, but some ferruginous stains. Seems to be a somewhat weathered sample.

No. 2651—COAL. *Forty-seven inches. G. M. Jones', Beech creek, Clay county. Sample of the upper* 32 *inches.* Collected by G. M. Hodge.

Somewhat weathered.

No. 2652—COAL. *Forty-seven inches. G. M. Jones', Beech creek. Sample of the lower* 15 *inches.* Collected by G. M. Hodge.

A much weathered sample.

No. 2653—COAL. *Bituminous,* 30 *inches; cannel coal,* 5 *inches. J. T. Smith's, Tom's Branch, Left Fork of Goose creek. Sample of the bituminous coal from* 15 *inches under.* Collected by G. M. Hodge. (See No. 2647.)

A much weathered sample, with reddish, ferruginous incrustation.

No. 2654—COAL. *Thirty-eight inches. Alvis Hubbard's, Katy's creek. Red Bird creek, Clay county.* Collected by G. M. Hodge.

A somewhat weathered sample.

No. 2655—CANNEL COAL. *J. T. Smith's, Tom's Branch Goose creek.* (See No. 2653.) *Bituminous coal,* 30 *inches; cannel coal,* 5 *inches.*

COMPOSITION OF THESE CLAY COUNTY COALS.

(Air Dried.)

Number in Report.	2647	2648	2649	2650	2651	2652	2653	2654	2655
Specific gravity	1.288	1.287	1.278	1.292	1.313	not est.	not est.	1.290	1.160
Hygroscopic moisture	1.10	1.20	1.48	1.46	0.92	0.42	2.80	1.60	0.30
Volatile combustible matters	35.60	38.10	35.92	34.84	37.54	32.38	29.40	34.28	44.16
Coke	63.30	60.70	62.60	63.70	61.54	67.20	67.80	64.12	55.54
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	36.70	39.30	37.40	36.30	38.46	32.80	32.20	35.88	44.46
Carbon in the coke	56.90	54.90	54.70	57.70	53.44	35.20	57.00	54.82	43.74
Ash	6.40	5.80	7.90	6.00	8.10	32.00	10.80	9.30	11.80
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	0.885	1.793	0.885	0.531	1.601	0.042	1.178	1.766	1.244
Character of the coke	light spongy.	spongy.	spongy.	spongy.	spongy.	dense.	dense friable.	dense spongy.	dense.
Color of the ash	lt. brownish-grey.	lilac-grey.	light lilac-grey.	nearly white.	lt. brownish-grey.	dark brown.	light brown.	purplish brown.	dark-grey.

The large proportion of ash of No. 2652, viz.: 32 per cent., greatly reduces its value, especially for transportation, and its more than 6 per cent. of sulphur would prevent its profitable use in the working of iron. Nos. 2655, 2654 and 2653, containing severally 11.80, 9.30 and 10.80 per cent. of ash, are proportionately reduced in value, especially for coke-making. The lowest ash proportions are found in Nos. 2648, 2650 and 2647, being 5.80, 6.00 and 6.40 severally. The large amount of ash in several of these Clay county coals would not prevent their profitable use as fuel in the vicinity of the several beds.

CLINTON COUNTY.

MINERAL WATER.

No. 2656—MINERAL WATER *from Sewell's Mountain, near Albany, Clinton county.*

Near the summit of Poplar or Sewell's Mountain. Issues from beneath a heavy ledge of carboniferous sandstone or conglomerate. Flow small. Temperature 52° F. Collected by R. H. Loughridge.

COMPOSITION IN 1000 PARTS OF THE WATER.

Iron carbonate	0.320	Held in solution by carbonic acid.
Lime carbonate	.011	
Magnesia carbonate	.021	
Silica	.020	
Potash and soda salts in minute quantity	not est.	
Total saline matters in 1000 parts of the water	0.372	

A weak chalybeate water. Good of its kind.

FLEMING COUNTY.

MINERAL WATERS.

No. 2657—CHALYBEATE WATER *from Fox Spring. Geological position: near the top of the corniferous group.* Collected by W. M. Linney.

No. 2658—WHITE SULPHUR WATER. *Fox Springs. Geological position: Black slate.* Collected by W. M. Linney.

COMPOSITION IN 1000 PARTS OF THE WATER.

Number in Report.	2657	2658
Carbonate of iron	0.0130	0.0016
Carbonate of lime	. . . . .	.0982
Carbonate of magnesia	. . . . .	.0430
Sulphate of iron	.0175	. . . . .
Sulphate of potash	.0244	.0142
Sulphate of soda	.0424	.0460
Sulphate of lime	.0483	. . . . .
Sulphate of magnesia	.0485	. . . . .
Chloride of sodium	trace.	.0427
Carbonate of soda	. . . . .	.0538
Silica	.0328	.0238
Organic matters and loess	.0121	.0802
Total	0.2390	0 4035

No. 2657 is a good saline chalybeate water. No. 2658 is an alkaline saline chalybeate, containing much less of salts of iron than the other.

Fulton County.

No. 2659—Grey Silt or Loess. *Near the top of the bluff at Hickman, Fulton county.* Collected by R. H. Loughridge.

Dried silt of greyish-cinnamon color. Clods friable. All passed through the coarse sieve, except a few small rock fragments. Its siliceous residue, from digestion in acids, all passed through the fine sieve.

COMPOSITION.—(Air Dried)

Alumina and manganese oxide	4.062
Iron peroxide	2.125
Lime carbonate	14.900
Magnesia carbonate	7.670
Phosphoric acid (P_2O_5)	.173
Potash extracted by acids	.521
Soda extracted by acids	1.082
Sand and insoluble silicates	67 295
Moisture, organic matters, etc.	2.172
Total	100 000
Potash in silicious residue	1.410
Soda in siliceous residue	1.268

(See No. 2142 in previous report for analysis of the lower portion of this bed.)

GRAVES COUNTY.

SOILS.

No. 2660—VIRGIN SOIL *of black-jack oak barren, three miles north-west of Mayfield. Taken to the depth of* 10 *inches. Growth: chiefly black-jack oak and some young red oaks.* Collected by R. H. Loughridge.

Dried soil of a grey-brown color. Clods friable. All passed through the coarse sieve.* Its siliceous residue, from digestion in acids, all passed through the fine sieve.†

No. 2661—SUBSOIL *of the next preceding. Taken from* 6 *to* 12 *inches deep.* Collected by R. H. Loughridge.

Dried subsoil of a grey-buff color. Clods comparatively firm. All passed through the coarse sieve. Its siliceousoresidue, from digestion in acids, all passed through the fine sieve.

COMPOSITION OF THESE GRAVES COUNTY SOILS.

(Calculated Dried at 212° F.)

Number in Report.	2660	2661
Organic and volatile matters	2.639	2.187
Alumina and manganese oxide	2.636	3.511
Iron peroxide	1.756	2.484
Lime carbonate	.096	.147
Magnesia	.159	.235
Phosphoric acid (P_2O_5)	.084	.049
Potash extracted by acids	.149	.110
Soda extracted by acids	not est.	.039
Water expelled at 380-400° F.	.696	1.156
Sand and insoluble silicates	91.295	89.818
Total	99.510	99.731
Hygroscopic moisture	0.915	0.575
Potash in siliceous residue	1.732	1.827
Soda in siliceous residue	1.461	.870
Character of the soil	virgin surface.	subsoil.

These may be characterized as light soils, containing moderate, or small proportions of organic matters, lime and phosphoric acid, with an average amount of potash Manures would be required to keep up fertility.

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* With 64 meshes to the centimeter square.

† With 1600 meshes to the centimeter square.

GRAVES COUNTY.

CLAYS.

No. 2662—ARENACEOUS CLAY (*from decomposing chert?*). *Railroad cut*, 3 *miles north of Boaz station. Quaternary.* Collected by R. H. Loughridge.

Lump of the hardness of chalk, of a fine granular texture; light-brownish-grey color. A portion of a small, whitish, rounded chert pebble in the sample. Somewhat plastic, very difficult to fuse before the blow-pipe.

No. 2663—CLAY, 3 *miles west of Linnville. Lagrange Tertiary group.* Collected by R. H. Loughridge.

Dried clay of a light-brownish-grey color. Fine textured. Infusible before the blow-pipe.

No. 2664—WHITISH PIPE-CLAY. *South of Guill Hill. Railroad cut*, 3 *miles south of Wingo. Tertiary.* Collected by R. H. Loughridge.

Dried clay of a light-brownish-grey color; nearly white. Of very difficult fusion before the blow-pipe.

No. 2665—CLAY. *Boaz Station.* Collected by R. H. Loughridge.

Dried clay, nearly white (light-brownish-grey). Fine textured. Very difficult to fuse before the blow-pipe.

No. 2666—CLAY *from Howard's pottery, at Bell City.* Collected by R. H. Loughridge.

Dried clay, nearly white (of a light-brownish-grey color), with some ferruginous stains. Fine textured. Infusible before the blow-pipe.

COMPOSITION OF THESE GRAVES COUNTY CLAYS.

(Air Dried.)

Number in Report.	2662	2663	2664	2665	2666
Silica	76.780	62.680	75.120	61.920	56.980
Alumina	14.740	25.880	15.960	30.060	32.160
Iron peroxide	1.640	2.900	1.420	.300	2 160
Lime	trace.	trace.	trace.	trace.	trace.
Magnesia	.389	.319	.317	.064	.209
Potash	1.440	1.147	1.351	1.602	.838
Soda	.117	.928	.245	.239	.111
Water, etc.	4.894	6.146	5.587	5.815	7.542
Total	100.000	100.000	100.000	100.000	100.000
Fine sand	2 400	not est.	not est.	not est.	16.44

The arenaceous clay, No. 2662, contains enough alumina to make it plastic enough for the manufacture of good fire-brick, etc. No. 2664 has an analogous composition, and had, probably, the same origin. The other clays are quite plastic, very refractory, and good for the manufacture of light-colored or white pottery-ware, fire-brick, etc., and terra-cotta.

HARLAN COUNTY.

COALS.

No. 2667—COAL. *Sixty-three inches. Dale Bledsoe's, Reuben Branch of Beech Fork of Middle Fork of Kentucky river.* Collected by G. M. Hodge.

A somewhat weathered sample. Has no apparent pyrites.

No. 2668—COAL (sample 4). *Three and a quarter miles above the mouth of Clover Lick creek of Poor Fork of Cumberland river. Outcrop sample from the exposure in the bed of the creek. Forty-one inches thick. A seam* 75 *to* 100 *feet below sample* 3. Collected by R. C. B. Thruston.

A slightly weathered sample.

No. 2669—COAL. *Six feet five inches thick. Right bank of Looney creek, about* 2 *miles above the mouth.* Collected by T. H. Morgan, August 24, 1885.

A much weathered sample, containing a few pieces of bright hard coal.

No 2670—COAL *on the land of E. Dickson, on Tantrough Branch of Poor Fork of Cumberland river, 20 miles from Mount Pleasant.* Coal No. 1. ? Collected by R. C. B. Thruston.

A much weathered sample.

No. 2671—COAL *a quarter of a mile up Tyrey's Branch of Clover Lick creek* (3 *miles above its mouth*) *of Poor Fork of Cumberland river.* Collected by R. C. B. Thruston. The coal shows, across Tyrey's Branch, 41 inches thick.

A weathered sample of the outcrop.

No. 2672—COAL *in Fickle's Cove of Looney creek, on J. Jenkins' land. Coal* 6 *feet* 4 *inches thick.*

A weathered sample.

No. 2673—COAL. *Right bank of Looney's creek, about* 2 *miles above the mouth. Coal* 4 *feet thick.* Collected by T. H. Morgan, August 24th, 1885.

A much weathered sample.

No. 2674—COAL (sample No. 5). *Garner's Hollow,* 15 *miles above the mouth of Poor Fork of Cumberland river. Cannel coal* 42 *inches, on land of John L. Cornett, beneath cannel shale.* Collected by R. C. B. Thruston.

No. 2675—COAL (sample No. 6). *Thirty-six inches thick. Garner's Spring,* 15 *miles above the mouth of Poor Fork. One hundred and forty feet above black limestone.*

A much weathered and dirty sample. (Dust was sifted out before analyzing.)

No. 2676—COAL (sample No. 7). *Head of Island Branch of Poor Fork of Cumberland river,* 16 *miles from Mount Pleasant;* 180 *feet above black limestone. Coal* 51 *inches thick, on land of John L. Cornett.* Collected by R. C. B. Thruston.

A much weathered sample. The dust was sifted out before analyzing.

No. 2677—COAL (sample No. 9). *Head of Island Branch of Poor Fork of Cumberland river. Soft coal below sample* 8, 23 *inches thick.* Collected by R. C. B. Thruston.

Somewhat weathered. The sample contained some slaty pieces, which were retained when it was analyzed.

COMPOSITION OF THE ABOVE DESCRIBED HARLAN COUNTY COALS.

(Air Dried.)

Number in Report.	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677
Hygroscopic moisture	1.60	1.12	3.40	1.60	1.40	2.30	2.50	1.00	4.62	6.08	1.90
Volatile combustible matters	33.30	33.68	31.08	35.00	32.20	33.30	34.30	29.50	32.98	32.72	36.00
Coke	65.10	65.20	65.52	63.40	66.40	64.40	63.20	69.50	62.40	61.20	62.10
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	34.90	34.80	34.48	36.60	33.60	35.60	36.80	30.50	37.60	38.80	37.90
Carbon in the coke	49.70	63.10	62.52	57.40	57.20	57.20	58.70	31.60	58.30	58.20	56.10
Ash	15.40	2.10	3.00	6.00	9.20	7.20	4.50	37.90	4.10	3.00	6.00
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	1.491	0.420	0.365	0.558	0.742	0.502	0.502	0.613	0.475	0.311	0.461
Character of the coke	spongy.	spongy.	friable.	spongy.	dense.	dense.	dense friable.	pulverulent.	pulverulent.	pulverulent.	spongy.
Color of the ash	lilac grey.	light brown'h.	lt. purple grey.	reddish brown.	lilac grey.	brown.	brown'h.	brown.	very lt. brown.	light brown.	light brown.

No. 2674 contains so much ash material, 37.9 per cent., as to cause it to be unprofitable for transportation or the manufacture of coke. The profitable use of its 61.1 per cent. of combustible materials could only be made near the bed. No. 2667 also contains more than a good average of ash. Several of these coals, especially those with little ash and sulphur, would make good coke. No. 2669, which gives only 3 per cent. of ash, presents the apparent anomaly of yielding a friable coke. This can only be explained by the fact that it was a much weathered sample. Very probably the coal, deeper in the bed where it has not been altered by the atmospheric agencies, will be found to give a spongy coke, like its neighboring coal in this schedule, No. 2668, which it resembles in composition.

HARLAN COUNTY COALS, ETC.—Continued.

No. 2678—COAL (sample 10), *from near the mouth of Island Branch of Poor Fork of Cumberland river, 16 miles from the Court-house of Harlan county. Coal 36 inches, with two thin partings of fibrous coal. Land of John L. Cornett.* Collected by R. C. B. Thruston.

A slightly weathered sample, containing some slaty pieces. Part of it is bright fat coal.

No. 2679—COAL (sample 13). *George Turner's bank, 1 mile above Mount Pleasant, in Big Black Mountain, on Clover Fork of Cumberland river. Coal 48 inches. No parting.* Collected by R. C. B. Thruston.

A bright pitch-black coal, fracture generally cuboidal and irregular. Very little fibrous coal apparent, but some granular pyrites.

No. 2680—COAL (sample 14). *Mr. Silas Woodson Kelly's, Yocum's creek, Clover Fork of Cumberland river. Sample from 2 seams, 22 and 17 inches thick severally, separated by 8 inches of shale. Lower 17-inch layer is very hard and rich.* Collected by R. C. B. Thruston.

Apparently a pretty good, firm splint coal, not much fibrous coal between the laminæ, and no apparent pyrites.

No. 2681—BITUMINOUS SHALE (sample 15). *Sharpe's creek of Yocum's creek of Clover Fork of Cumberland river. Land of John Farley. Shale* 15 *inches thick, above coal* 25 *inches thick.* Collected by R. C. B. Thruston.

No. 2682—COAL (sample No. 16). *Twenty-five inches of the bed above described.* Collected by R. C. B. Thruston.

A bright pitch-black coal, breaking generally irregular cuboidal. Very little fibrous coal and no pyrites apparent in the sample.

No. 2683—COAL (sample 17). *Right Hand Fork of Yocum's creek of Clover Fork of Cumberland river. Land of Wright Winn.* Collected by R. C. B Thruston. Coal 31½ inches in all, with a clay parting.

Portions breaking somewhat irregularly; pitch-black, with shining surfaces. Other portions dull black, breaking in irregular laminæ, with but little fibrous coal between them, and no apparent pyrites.

No. 2684—COAL (sample 18). *Turkey-pen Branch of Poor Fork,* 14 *miles above Harlan Court-house. Land of Jonathan Cornett. Coal* 39 *inches thick.* Collected by R. C. B. Thruston. Sample from the lower 39-inch seam.

A somewhat weathered sample of what appears to be a splint coal, much of the sample in a powdered condition. Some fibrous coal and softer, brighter lumps in the sample.

No. 2685—COAL (sample 19). *On Isaac Creech's land on Mud Lick Fork of Seagreaves creek of Clover Fork of Cumberland river.* Collected by R. C. B. Thruston. Sample from the 23, 11 and 5-inch seams, which are parted by thin shale layers.

A pitch-black coal, breaking generally into irregular laminæ with shining surfaces. Some pieces more dull. Some bright scales of pyrites and fibrous coal apparent.

No. 2686—COAL (sample 20). *Child's creek of Clover Fork of Cumberland river.* Collected by R. C. B. Thruston. Sample of 40 inches of the 44-inch seam near the bottom of the bed.

Sample from the outcrop, badly weathered. The bed has a soil roof and is opened at the side of a bridle path.

No. 2687—Coal (sample 21). *Child's creek of Clover Fork of Cumberland river. Three hundred feet below sample* 20. Collected by R. C. B. Thruston. Sample from the 21, 5 and 11-inch seams. One shale parting. Sandstone roof.

A hard splint coal, dull black, with but little fibrous coal and no apparent pyrites.

No. 2688—Coal (sample 22). *On Buck Branch of Child's creek of Clover Fork.* Sample includes all the 3 seams of the bed, 10, 13 and 11 inches severally, which are parted by thin layers of shale. Collected by R. C. B. Thruston.

Generally splint coal. But little fibrous coal and no pyrites apparent. Some ferruginous incrustation. Portions breaking irregularly, with pitch-black, irregular surfaces.

COMPOSITION OF THE ABOVE DESCRIBED HARLAN COUNTY COALS.

(Air Dried.)

Number in Report.	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688
Hygroscopic moisture	2.02	1.76	1.60	1.04	1.50	1.52	1.84	1.58	6.18	2.20	1.80
Volatile combustible matters	32.98	34.64	37.70	21.88	35.30	33.00	31.12	31.82	34.24	33.52	35.00
Coke	65.00	63.60	60.70	77.08	63.20	65.48	67.04	66.60	59.58	64.28	63.20
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	35.00	36.40	39.30	22.92	36.80	34.52	32.96	33.40	40.42	35.72	36.80
Carbon in the coke	52.70	60.50	54.84	29.60	60.24	51.96	62.28	63.20	52.88	55 72	57.30
Ash	12.30	3.10	5.86	47.48	2.96	13.52	4.76	3.40	6.70	8.56	5.90
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Cercentage of sulphur	0.546	0.904	0.958	5.486	1.041	0.684	0.794	1.288	0.519	0.656	0.986
Character of the coke	spongy.	light spongy.	light spongy.	pulverulent.	dense spongy.	dense spongy.	dense spongy.	spongy.	pulverulent.	dense friable.	dense spongy.
Color of the ash	light salmon.	very lt. grey.	light brown.	purplish brown.	brown.	light grey.	light buff.	brown.	light buff.	lt. yel'h-grey.	lt. grey'h brown.

The bituminous shale, No. 2681, with its 47.48 per cent. of ash, yet contains 51.48 per cent. of combustible matters, volatile and fixed, including 5.436 per cent. of sulphur. It would not bear the cost of distant transportation, nor could it well be used for fuel for most manufacturing purposes, yet it may find profitable application in the close vicinity of the bed.

Several of these coals above described are very good coking coals, especially those which leave but little ash and contain a small proportion of sulphur. Coal No. 2686, which contained so much moisture—6.18 per cent., and left only a pulverulent coke—being a much weathered sample, may be found a good coking coal deeper in the bed, where it has been protected from the atmospheric agencies.

HARLAN COUNTY COALS—Continued.

No. 2689—COAL (sample 23). *Buck Branch of Child's creek of Clover Fork. Three hundred and twenty-five feet above sample* 22. Collected by R. C. B. Thruston. Sample from all the coals of the bed.

A mixed sample. Some splint coal, with fibrous coal between the laminæ, but no apparent pyrites; other portions breaking irregularly, with pitch-black, shining surfaces.

No. 2690—COAL (sample 24). *Baily Hollow of Clover Fork,* 20½ *miles above Mount Pleasant;* 135 *feet above drainage.* Collected by R. C. B. Thruston.

Sample from 36 and 8-inch layers. The 36-inch coal is a fat coking coal, with four bands of fibrous coal. The 8-inch coal below is harder, with some little splint coal.

The bed has five several seams of coal, in all 65 inches, separated by five layers of shale, in all 41 inches. With sandstone roof.

No. 2691—COAL (sample 25). *Head of Child's creek of Clover Fork, within* 20 *yards of the State line,* 360 *feet above sample* 20. *Sample from the upper* 24-*inch coal.*

The bed contains four seams of coal, separated by three layers of shale, with a conglomerate sandstone roof.

The sample seems to have been weathered.

No. 2692—Coal (sample 26), *of the 24-inch splint coal in the bed described under the next preceding number.* Collected by R. C. B. Thruston.

Contains some fibrous coal, but no apparent pyrites. Some pieces break irregularly, with bright shining, pitch-black, irregular surfaces.

No. 2693—Coal (sample 27). *Near head of Child's creek of Clover Fork,* 380 *feet below sample* 26. (*The same as sample* 20 (*No.* 2686), *but from a better opening. This sample not as much weathered as that.*)

Mostly splint coal, showing but little fibrous coal and no apparent pyrites. Some portions softer coal, breaking somewhat irregular, with bright irregular pitch-black surfaces.

No. 2694—Coal (sample 28). *Right-hand Fork of Breeding Creek of Clover Fork.* Collected by R. C. B. Thruston. (Splint coal 6 inches, shop coal 26 inches.)

Generally hard, dull-black, breaking into irregular laminæ with but little fibrous coal, and no apparent pyrites.

No. 2695—Coal (sample 29). *Three feet six inches. Elkaner Winn. Branch of Clover Fork. The upper* 15 *inches is splint coal, showing some pyrites and fibrous coal. The rest is a fat coal, with more pyrites, sometimes in quantity together.* Collected by R. C. B. Thruston.

Generally a pure-looking coal, mostly breaking with bright irregular surfaces, pitch-black. Some portions more dull, breaking into laminæ, with fibrous coal between. Some bright pyrites apparent.

No. 2696—Coal (sample 30). *Low Gap Branch of Child's creek of Clover Fork,* 16 *feet above sample* 20. *Sample from the* 16 *and* 3-*inch layers in the bed.* (*So-called shop coal.*) Collected by R. C. B. Thruston.

The bed shows six layers of coal, alternating with seams of shale. Sandstone roof.

No. 2697—Coal (sample 31, page 20). *Head of Laurel Fork of Seagreaves creek of Clover Fork. Two hundred feet above* *fossiliferous limestone. Sample from the upper 70-inch layer.* Collected by R. C. B. Thruston.

The bed, with soil roof, has its 70-inch upper layer separated by 26 inches of shale from a lower 6-inch coal seam. Mostly splint coal badly weathered, with some clay intermixed.

No. 2698—COAL (sample 31, page 13). *Low-gap Branch of Child's creek of Clover Fork of Cumberland river. Fifteen feet above sample* 20. *Sample from the* 36-*inch seam. Splint coal.* Collected by R. C. B. Thruston.

Bed with five seams of coal, separated by four layers of shale, etc. Sandstone roof. Sample shows but little fibrous coal and no pyrites.

No. 2699—COAL. *Green Jones', near mouth of Martin's Fork.*

Bed contains two seams of coal, 49½ and 13 inches severally. A pure-looking pitch-black coal, breaking irregularly cuboidal with irregular shining surfaces. A very little bright pyrites, but no fibrous coal apparent.

COMPOSITION OF HARLAN COUNTY COALS—Continued.

(Air Dried.)

Number in Report.	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699
Hygroscopic moisture	1.80	2.46	4.50	2.50	2.00	2.06	1.80	2.00	3.10	2.16	1.68
Volatile combustible matters	33.60	31.94	33.00	38.60	36.80	37.34	37.10	35.00	36.10	34.14	35.72
Coke	64.60	65.60	62.50	58.90	61.20	60.60	61.10	63.00	60.80	63.70	62.60
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	35.40	34.40	37.50	41.10	38.80	39.40	38.90	37.00	39.20	36.30	37.40
Fixed carbon in coke	55.20	61.20	58.90	53.04	55.86	57.70	56.70	52.20	56.60	55.50	60.20
Ash	9.40	4.40	3.60	5.86	5.34	2.90	4.40	10.80	4.20	8.20	2.40
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	0.821	0.588	0.628	1.425	0.958	0.574	0.964	0.959	0.794	0.684	0.574
Character of the coke	spongy.	dense.	pulver ulent.	spongy.	light spongy.	spongy.	light spongy.	dense.	dense.	dense.	dense.
Color of the ash	(purp'h) nearly white.	light brown.	salmon colored	greyish brown.	purplish grey.	purplish grey.	lt. pur'h grey.	lt. pur'h grey.	greyish brown.	light grey.	light brown'h grey.

All of these coals are good, and most of them very good, they containing generally but small proportions of ash and sulphur. The best of them are Nos. 2699, 2694, 2691, 2697, 2690, 2695, 2693 and 2692, arranged in the order of their ash percentage.

The relative ash percentage, however, does not always show their exact comparative value as fuel, as may be seen in the following table:

Number.	Ash Percentage.	Volatile Combustible Matters.	Fixed Carbon.	Total Combustible Matters.
2699	2.40	35.72	60.20	95.92
2694	2.90	37.34	57.70	95.04
2691	3.60	33.00	58.90	91.90
2697	4.20	36.10	56.60	92.70
2690	4.40	31.94	61.20	93.14
2695	4.40	37.10	56.70	93.80
2693	5.34	36.80	55.86	92.66
2992	5.86	38.60	53.04	91.64

No. 2692 contains the largest proportion of sulphur, viz.: 1.425 per cent., to be deducted from the total combustible matters; but it also contains the largest proportion of volatile combustible matters, viz.: 38.60 per cent.

Nos. 2696, 2689 and 2698, containing more ash materials than those above tabulated, yet are good fuels, containing large proportions of combustible matters, as shown below:

Number.	Ash Percentage.	Volatile Combustible Matters.	Fixed Carbon.	Total Combustible Matters.
2696	10.80	35.00	52.20	87.20
2689	9.40	33.60	55.20	88.80
2698	8.20	34.14	55.50	89.64

The weathered samples, with their large proportions of hygroscopic moisture, of course show smaller proportions of combustible matters than may be found in the same coals deeper in the bed.

HARLAN COUNTY COALS—Concluded.

No. 2700—COAL (sample 33). *Seagreaves creek of Clover Fork. Sample from the whole 39 inches.* Collected by R. C. B.

Thruston. (Considerable pyrites and some fibrous coal low down in the series.)

The sample contains some splint coal, but is mostly coal which breaks irregularly cuboidal, with shining, irregular surfaces, having little or no pyrites or fibrous coal. (The upper 3 inches of the bed is splint coal.)

No. 2701—COAL (sample 34). *Seagreaves creek of Clover Fork of Cumberland river, 400 feet below fossiliferous limestone. Sample from the 39 inches, the upper layer, 28 inches, being of shop-coal; the lower 11 inches, separated from this by 6 inches of indurated clay, is splint coal.* Collected by R. C. B. Thruston.

A badly weathered sample, showing some fibrous coal but no pyrites.

No. 2702—COAL (sample 35). *Fugit creek of Clover Fork. Sample from the main 41-inch layer of the bed The coal is mainly splint, containing very little fibrous coal or pyrites.* Collected by R. C. B. Thruston.

A firm splint or block coal. Some pieces breaking irregularly with shining surfaces.

No. 2703—COAL (sample 36). *Steep Hollow or Coal Branch of Clover Fork, on land of John M. Smith, 16.82 miles above Mount Pleasant. Sample from the 37-inch cannel coal.* Collected by R. C. B. Thruston.

This layer is at the bottom of the bed.

No. 2704—COAL (sample 37). *White Oak Branch of Yocum's creek of Clover Fork. Sample from the 50-inch layer, which is nearly all shop-coal and hard.* Collected by R. C. B. Thruston.

Seems to be generally a good firm splint or block coal.

No. 2705—COAL (sample 38). *Sample from the 25-inch layer, mainly rich shop-coal. Bottom of the same bed as the next preceding sample.* Collected by R. C. B. Thruston.

A good sample of firm semi-cannel or block coal.

No. 2706—COAL (sample 39). *Gray's Branch of Martin's Fork, 5 miles from Mount Pleasant. Sample from the 28* *and 26-inch layers. Fat coking coal, except* 3 *inches of splint coal at the bottom of the 26-inch layer.* Collected by R. C. B. Thruston.

A badly weathered sample. The bed contains four layers of coal separated by seams of shale.

No. 2707—COAL (sample 45). *Frank's Branch of Yocum's creek of Clover Fork. Sample from the 48-inch seam.* Collected by R. C. B. Thruston.

Some fibrous coal, but no pyrites apparent. A somewhat weathered sample.

No. 2708—COAL. *John L. Cornett's, Poor Fork of Cumberland river. Average sample of coal sent for coking.* By R. C. B. Thruston, January, 1886.

A somewhat dull-looking sample of splint coal, breaking into thin irregular laminæ. Some fibrous coal between, but no apparent pyrites.

No. 2709—COAL. *Milton Hensley's. Wallen's creek of Cumberland river. Average sample of the coal tested for coking.* R. C. B. Thruston.

No. 2710—COAL. *S. S. Branson, Clover Lick creek of Poor Fork of Cumberland river. Average sample of coal tested for coking.* R. C. B. Thruston.

COMPOSITION OF HARLAN COUNTY COALS—Concluded.

(Air Dried.)

Number in Report.	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710
Hygroscopic moisture	1.52	4.64	1.56	1.56	1.74	1.56	2.98	1.44	1.26	2.20	1.30
Volatile combustible matters	34.88	29.16	35.04	42.64	31.76	35.24	32.02	33.56	29.20	36.70	37.10
Coke	63.60	66.20	63.40	55.80	66.50	63.20	65.00	65.00	69.54	61.10	61.60
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	36.40	33.80	36.60	44.20	33.50	36.80	35.00	35.00	30.46	38.90	38.40
Fixed carbon	60.70	55.20	60.80	46.48	57.10	58.00	55.30	62.80	56.68	58.86	58.24
Ash	2.90	11.00	2.60	9.32	9.40	5.20	9.70	2.20	12.86	2.24	3.36
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	0.615	0.986	0.835	0.574	0.656	0.931	0.692	0.849	0.848	0.277	1.290
Character of the coke	dense spongy.	pulverulent.	light spongy.	dense.	dense spongy.	friable.	pulverulent.	dense.	dense spongy.	light spongy.	dense spongy.
Color of the ash	brown'h grey.	very lt. brown'h grey.	light brown'h grey.	grey'h brown.	light grey.	very light grey.	light grey.	light brown grey.	grey.	light brown.	light brown. grey.

Several of these coals, especially those which give small proportions of ash, would yield very good coke, and even those with the largest percentage of ash material would be very good fuel for all ordinary purposes. Calculating their proportions of combustible materials, according to the method used in the table next preceding the above, even No. 2708, with its 12.86 per cent. of ash, contains 85.88 per cent. of combustible matters, including its 0.848 per cent. of sulphur, and No. 2706, with its 9.70 per cent. of ash, contains 87.32 per cent. of combustible matters, including 0.692 per cent. of sulphur. This, as well as Nos. 2701 and 2709, are weathered samples, and No. 2703 is a cannel coal, as is indicated by its large percentage of volatile combustible matters.

The very best of these coals are Nos. 2707, 2709, 2702 and 2700, arranged in the order of their ash percentage, the first having only 2.20 and the last-named 2.90 per cent. These contain from 96.36 in No. 2707 to 95.58 per cent. in No 2700 of total combustible matters. The others fall in between these two extremes.

HARLAN COUNTY COKES.

No. 2711—COKE (No. 11). *Made of Wallen's creek coal, Harlan county, Kentucky. Forty-eight hour coke made at Quinnimont, West Virginia*, March 22 and 24, 1886. R. C. B. Thruston.

No. 2712—(COKE No. 10). *Made from coal of John L. Cornett, Island Branch of Poor Fork, Harlan county. Seventy-two hour coke made at Quinnimont, West Virginia*, March 20-23, 1886. R. C. B. Thruston.

No. 2713—COKE (No. 9). *Made from coal of S. S. Branson, Clover Lick creek of Poor Fork, of Cumberland river*, Harlan county. *Seventy-two hour coke, made at Quinnimont, West Virginia*, March 20-23, 1886. R. C. B. Thruston.

No. 2714 (No. 11). *Made of Whallen's creek coal*, Harlan county. *Seventy-two hour coke, made at Quinnimont, West Virginia*, March 20-23, 1886. R. C. B. Thruston.

COMPOSITION OF THESE HARLAN COUNTY COKES.

(Air Dried.)

Number in Report.	2711	2712	2713	2714
Moisture, etc., expelled at red heat	0.60	1.34	0.40	0.90
Fixed carbon	93.10	80.76	93.60	92.90
Ash	6.30	17.90	6.00	6.20
Totals	100.00	100.00	100.00	100.00
Percentage of sulphur	0.546	0.648	1.068	0.368
Color of the ash	brownish grey.	light grey.	light grey brown.	grey. brown.
Hours of coking	48	72	72	72

With the exception of No. 2712, which contains too much ash material, these have the composition of very good cokes.

Their degree of porosity, or their power to resist pressure, were not tested, but they all appear to be good firm, dense cokes. It is a fact, however, known to most manufacturers of coke, that its density or porosity depends somewhat on the pressure which is applied to it in the oven when in its soft condition in the act of coking.

Hence, the lower portion of a bed of coke, which has been measurably coked by the heat of the oven before much weight of coal is applied, is generally more porous and spongy than that which is subsequently formed under the load of the full charge of coal. No doubt different coals, under similar conditions, will give cokes of very different degrees of density, and possibly, also, the length of time given to the process, and the mode of application of the heat, whether gradual or sudden, may affect the porosity and density of the coke.

HICKMAN COUNTY.

CLAYS.

NO. 2715—FIRE-CLAY. *Bluff above Columbus, sixty-five feet above low water. Below gravel.* Collected by John R. Procter.

A fine sandy clay, of a light grey color. Infusible before the blow-pipe.

COMPOSITION.—(Air Dried.)

Silica	85.180
Alumina	10.260
Iron peroxide	1.120
Lime	trace.
Magnesia	.064
Potash	.954
Soda	.146
Water, etc.	2.276
	100.000
Fine sand (per cent.)	70.100

This so-called clay owes its plastic properties to the state of very fine division of the large quantity of siliceous sand which it contains, its 10.260 per cent. of alumina being equivalent to only 25.920 per cent. of kaolin, the basis of true clay.

It appears to be quite refractory in the fire, notwithstanding its nearly one per cent. of potash. No doubt it could find profitable applications: in the ceramic art; as a scouring material; in glass manufacture; or for fire-proof linings, etc.

No. 2715 (*a*). RED OCHREOUS CLAY. *Below gravel. Columbus Bluff.* Collected by John R. Procter.

Of a dull pink color. Calcines of a purplish-brown color. Quite plastic. Washed in water, it yielded 36.69 per cent. of fine sand.

It owes its color to hydrated peroxide of iron, like the ochres described under Ballard and Calloway counties, Nos. 2572 and 2651 (which see). It could no doubt be used as a cheap pigment (after washing it), either in its raw state or after calcination, or applied in terra-cotta works.

JEFFERSON COUNTY SOIL.

No. 2716—SOIL (Surface). Collected by George Crum *from a farm near Louisville. Characterized as a mucky soil, which fails to produce crops.* Appears to belong to the Devonian black shale formation. The sample was sent to Prof. M. A. Scovell, Director of Agricultural Experiment Station (No. 25), at the State College of Kentucky, for analysis.

When received in a bottle it was wet and plastic like clay, but it dried readily when exposed in a dry atmosphere. The dried soil is of dirty drab color. Clods friable.

All passed through the coarse sieve except 5.7 per cent. of shot-iron ore. Dried at 212° F., it lost only 1.7 per cent. of hygroscopic moisture.

COMPOSITION.—(Dried at 212° F.)

	Per Cent.
Organic and volatile matters	5.100
Alumina	10.524
Iron peroxide	3.795
Carbonate of lime	.140
Magnesia	.458
Phosphoric acid (P_2O_5)	.176
Potash extracted by acids	.191
Soda extracted by acids	.201
Water expelled at 380° F	1.000
Fine sand and insoluble silicates	78.950
	100.535
Hygroscopic moisture	1.700
Potash in the siliceous residue	1.855
Soda in the siliceous residue	.229

The chemical composition of this soil is such as characterizes productive soils generally, with the exception that the alumina is in large proportion, and the lime somewhat below a good average; but its physical condition, causing it to be quite plastic and adhesive when wet, and no doubt its local position, where it is subjected to an excess of water, are unfavorable to productiveness.

Thorough draining to carry off the excess of water, and the free use of lime, would very probably make it productive.

JOHNSON COUNTY.

COALS.

No. 2717—COAL. *Walter Fletcher's, Little Paint creek. Cannel coal, from the upper twenty-two inches of the forty-three inch bed. Sample taken from the specimen at the Exposition.** By R. C. B. Thruston. Collected by G. M. Hodge.

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*At New Orleans.

A pure-looking cannel coal. No apparent pyrites or fibrous coal.

No. 2718—COAL *from same bed. Sample of the lower twenty-one inches. Bituminous or splint coal.* By R. C. B. Thruston. Collected by G. M. Hodge.

A very pure-looking coal.

COMPOSITION OF THESE COALS.—(Air Dried.)

Number in Report.	2717	2718
Specific gravity	1.242	1.275
Hygroscopic moisture	1.44	2.56
Volatile combustible matters	50.22	39.94
Coke	48.34	57.50
Totals	100.00	100.00
Total volatile matters	51.66	42.50
Fixed carbon in the coke	40.74	54.10
Ash	7.60	3.40
Totals	100.00	100.00
Percentage of sulphur	0.837	1.030
Character of the coke	dense.	spongy.
Color of the ash	light buff.	light buff.

Both very good coals. The cannel coal is distinguished by its larger proportions of volatile combustible matters and ash, as well as by its lower specific gravity, notwithstanding its much larger ash percentage.

KNOTT COUNTY COALS.

No. 2719—COAL *on John Amburgy's land, Wolf Run Branch of Amburgy's Branch of Carr Fork of Kentucky river.* Sampled for analysis from the specimen at the New Orleans Exposition (1885) by R. C. B. Thruston. Collected by G. M. Hodge. The upper portion of the bed bituminous coal.

Apparently a much weathered sample. Friable, and soiled with earthy matter, which will increase its moisture, etc.

No. 2720—COAL *of the same bed, etc., the lower twenty-five inches. Cannel coal, etc.*

A pure-looking cannel coal.

COMPOSITION OF THESE KNOTT COUNTY COALS.

(Air Dried.)

Number in Report.	2719	2720
Specific gravity	1.355	1.206
Hygroscopic moisture	6.48	0.72
Volatile combustible matters	29.78	44.40
Coke	63.74	54.88
Totals	100.00	100.00
Total volatile matters	36.26	45.12
Fixed carbon in the coke	60.64	47.00
Ash	3.10	7.88
Totals	100.00	100.00
Percentage of sulphur	0.598	0.753
Character of the coke	pulverulent.	dense.
Color of the ash	salmon colored.	light buff.

Very good coals, exemplifying the distinctive characters of cannel and bituminous coals, with this qualification, that the bituminous coal, having been much more altered by "weathering" than the cannel coal, contains much more hygroscopic moisture, and gives a pulverulent coke instead of a spongy one, which it would no doubt yield if in the unweathered condition. Deeper in the bed, this layer of the coal would probably be found much better in quality.

KNOX COUNTY COALS.—Continued.

No. 2721—COAL. *Noah Wiggins', Fighting creek of Cumberland river. Average sample from the coal sent for coking.* Collected by R. C. B. Thruston.

A bright splint coal, breaking with irregular shining surfaces. Some fibrous coal between the irregular laminæ.

No. 2722—COAL. *Sandy Branch, near Flat Lick. A sample of the coal sent for coking. Collected two years ago.* R. C. B. Thruston.

No. 2723—Coal. *O. P. Ely's, Flat Lick. Average sample of the coal collected two years ago.* Collected by R. C. B. Thruston.

No. 2724—Coal. *Pursifull seam, near Flat Lick. Average sample of coal collected two years ago.* R. C. B. Thruston.

COMPOSITION OF THESE KNOX COUNTY COALS.

(Air Dried.)

Number in Report.	2721	2722	2723	2724
Hygroscopic moisture	1.20	1.80	2.00	1.20
Volatile combustible matters	38.80	36.60	35.30	35.08
Coke	60.00	61.60	62.70	63.72
Totals	100.00	100.00	100.00	100.00
Total volatile matters	40.00	38.40	37.30	36.28
Fixed carbon in the coke	58.86	58.12	61.90	58.92
Ash	1.14	3.48	0.80	4.80
Totals	100.00	100.00	100.00	100.00
Percentage of sulphur	0.615	0.884	0.766	0.766
Character of the coke	spongy.	spongy.	dense. spongy.	light spongy.
Color of the ash	dark salmon col'd.	lt. brown grey.	light brown.	very light brown.

These are all remarkably good coals, which would yield good cokes. The exceptional small ash percentage of No. 2723 was verified by repetition with the same sample..

KNOX COUNTY COKES.

No. 2725—Coke *from Noah Wiggins' coal, Fighting creek, Cumberland river. Seventy-two hours' coke.* Made at Quinnimont, West Virginia. R. C. B. Thruston.

No. 2726—Coke *from coal of Sandy Branch, near Flat Lick. A forty-eight hour coke.* Made at Quinnimont, West Virginia. R. C. B. Thruston.

No. 2727—Coke *from O. P. Ely's coal, Flat Lick.* Seventy-two hours' coke. Made at Quinnimont. R. C. B. Thruston.

No. 2728—COKE *from coal of Pursifull seam, near Flat Lick.* Seventy-two hour coke. Made at Quinnimont. R. C. B. Thruston.

COMPOSITION OF THESE KNOX COUNTY COKES.

(Air Dried.)

Number in Report.	2725	2726	2727	2728
Moisture, etc.	0.90	0.40	0.50	0.90
Fixed carbon	95.90	93.70	96.00	90.70
Ash	3.20	5.90	3.50	8.40
Totals	100.00	100.00	100.00	100.00
Percentage of sulphur	0.546	0.478	0.217	0.546
Color of the ash	reddish brown.	brownish grey.	brown.	brownish grey.

These are all remarkably good cokes, so far as chemical composition can determine.

LAUREL COUNTY COALS.

No. 2729—CANNEL COAL *of Frederick Wiedmer, one mile from London,* Laurel county. Sample brought to the laboratory by John R. Procter.

Somewhat laminated. Portions resembling bituminous shale. Showing some minute specks of mica.

No. 2730—COAL *of the Pitman Coal Company, Pittsburg, Laurel county. Sample from the coal selected two years ago for coking.* By R. C. B. Thruston.

COMPOSITION OF THESE LAUREL COUNTY COALS.

(Air Dried.)

Number in Report.	2729	2730
Hygroscopic moisture	0.60	2.56
Volatile combustible matters	31.66	34.56
Coke	67.74	62.88
Totals	100.00	100.00
Total volatile matters	32.26	37.12
Fixed carbon in the coke	45.24	59.58
Ash	22.50	3.30
Totals	100.00	100.00
Percentage of sulphur	not est.	0.895
Character of the coke	dense.	spongy.
Color of the ash	dark purplish-grey.	light grey.

No. 2730 is a very good, rich coal, well suited for the manufacture of coke, as the report below demonstrates.

No. 2729 may answer well for fuel in its own vicinity, but its high ash percentage might preclude distant transportation.

No. 2730*a*—COKE *of the Pitman Coal Company's coal* (*No.* 2730). *Seventy-two hour coke.* Made at Quinnimont, West Virginia, March 20–27, 1886. R. C. B. Thruston.

COMPOSITION. (Air Dried.)

Moisture, etc., expelled at red heat	0.50
Fixed carbon	92.60
Brownish-grey ash	6.90
	100.00
Percentage of sulphur	0.615

This appears to be a very good coke. Much of the sulphur of the coal was burnt out in coking.

LAWRENCE COUNTY.

PETROLEUM.

No. 2731—PETROLEUM *from the F. F. well, on Blain creek, land of the Vinson Oil Company, Lawrence county.* Sample sent by John R. Procter. (Received January 9, 1885.)

A thick petroleum, of the consistence of molasses; of a brown color, from admixture of earthy matters, colored with iron peroxide and water, of which some separates on standing. It is an emulsion of dense petroleum with water containing earthy matters, colored with ferric oxide.

It was submitted to fractional distillation with following results:

Kerosene oil (so-called)	14.31	Specific gravity, 0.795 to 0.836, boiling from 338° to 530° F.
Mineral sperm oil (so-called)	2.18	Specific gravity, .849; boiling point 520° to 580°.
Lubricating oil (so-called)	1.45	Specific gravity, not est.; boiling point, 580° to 600°.
Water	31.81	
Denser oils and sediment	50.25	
	100.00	

The distillation was not completed because of the breaking of the flask and the limited quantity of the sample.

No. 2732—PETROLEUM *from Lower Laurel well,* 320 *to* 330 *feet deep. Yields about* 100 *gallons per day. Well No.* 1, *on Lower Laurel creek, about* 1 *mile from the mouth of the creek.* Sample sent to Prof. Crandall by W. R. M. Broas, of Ashland, November 15, 1885.

A brownish-black, rather thick fluid, of specific gravity 0.853, containing very little water.

It was submitted to distillation in an iron retort until 91.4 per cent. had passed over. This, called the *first distillate*, was submitted to fractional distillation, with results stated below, under the head *second distillation.* The residue in the iron retort, of specific gravity 0.860, is noted there as No. 7, or *first distillate.*

This *first distillate*, submitted to *second distillation*, gave the following products:

			Specific gravity.
No. 1.	Distilling below 266° F. . . . =	to 11.2 p. c. of the crude petroleum	= 0.724
No. 2.	Distilling from 266° to 320° F. =	to 5.1 p. c. of the crude petroleum	= 0.755
No. 3.	Distilling from 320° to 428° F. =	to 14.4 p. c. of the crude petroleum	= 0.786
No. 4.	Distilling from 428° to 518° F. =	to 13.8 p. c. of the crude petroleum	= 0.817
No. 5.	Distilling from 518° to 608° F. =	to 10.8 p. c. of the crude petroleum	= 0.840
No. 6.	Distilling from above 608° F. =	to 15.7 p. c. of the crude petroleum	= 0.855
No. 7.	Product of the first distillation in iron retort . . . . =	to 19.6 p. c. of the crude petroleum	= 0.860
	Coke	3.3	
	Gas, water and loss	6.1	
		100.0	

These products would fall nearly under the following commercial heads, viz:

No. 1. Mostly Gasoline and Naphtha.
No. 2. A. Naphtha.
No. 3. Kerosene, or so-called coal-oil.
No. 4. Mineral sperm oil
No. 5. Fine lubricating oil; spindle oil.
Nos. 6 and 7. Paraffine oils, from which heavy lubricating oils and solid paraffine may be obtained.

LESLIE COUNTY.

COALS.

No. 2733—COAL. *McClellan Schell's. Bed* 73 *inches thick. Upper Double Branch of Greasy creek.* Collected by G. M. Hodge.

A weathered and somewhat soiled sample of what seems to be a good coal.

No. 2734—COAL. *Nicholas Schell's. Bed* 64 *inches thick. Upper Double Branch of Greasy creek.* Collected by G. M. Hodge.

Seems to be a splint coal. Sample somewhat weathered. Some little fibrous coal, but no pyrites apparent.

No. 2735—COAL. *Bed* 44 *inches thick. Lewis' Branch of Greasy creek. The lower* 7 *inches was not sampled.* Collected by G. M. Hodge.

A somewhat weathered sample of what seems to be a good splint coal.

No. 2736—COAL. *Bed* 83 *inches thick. Head of Pace Trace, White Oak creek. Sample from the lower* 53 *inches.* Collected by G. M. Hodge.

A weathered sample of what seems to be a good splint coal.

No. 2737—COAL. *Bed* 69 *inches thick. William Sisemore's, Rockhouse creek. The bottom* 6 *inches not sampled.* Collected by G. M. Hodge.

A pure-looking, firm coal, generally breaking irregularly, with irregular shining surfaces. A portion with lamellar fracture, and some fibrous coal; no pyrites apparent.

No. 2738—COAL. *Jesse Morgan's. Sixty-five inches thick. On Middle Fork.* Collected by G. M. Hodge.

Resembles the next preceding. Seems to have more splint coal.

No. 2739—CANNEL COAL. *Jerry Ledington's. Thirty-eight inches thick. Beech Fork, mouth of Oldham Branch.* Collected by G. M. Hodge.

No. 2740—COAL. *Sixty-one inches thick. Wesley McFadden's. Big creek. Red Bird creek.* Collected by G. M. Hodge.

No pyrites apparent, and but little fibrous coal.

No. 2741—COAL. *Bed 57 inches thick. Richard Collins'. Hal's Fork. Big creek. Red Bird creek.* Collected by G. M. Hodge.

No apparent pyrites, and but little fibrous coal.

No. 2742—COAL. *Bed 53 inches thick. Asper's Bank, Middle Fork of Kentucky river, two miles below Hyden.* Collected by G. M. Hodge.

Some fibrous coal between the laminæ, but no apparent pyrites.

No. 2743—COAL. *Bed 46 inches thick. Silas Nantz's, Oldhouse Branch, Beech Fork, Middle Fork of Kentucky river.* Collected by G. M. Hodge.

Seems to be somewhat weathered. Ferruginous incrustation on some pieces. Some fibrous coal apparent, but no pyrites.

COMPOSITION OF THESE LESLIE COUNTY COALS.

(Air Dried.)

Number in Report.	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743
Specific gravity	1.342	1.368	1.251	1.509	1.279	1.291	not est.	1.822	1.285	1.321	1.502
Hygrometric moisture	3.20	1.72	1.72	9.40	0.74	0.70	1.10	1.60	1.40	1.80	1.30
Volatile combustible matters	29.70	35.68	35.02	32.20	36.06	34.70	44.20	34.94	35.68	34.14	32.36
Coke	67.10	62.60	63.26	58.40	63.20	64.60	54.70	63.46	62.92	64.06	66.34
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	32.90	37.40	36.74	41.60	36.80	35.40	45.30	36.54	37.08	35.94	33.66
Fixed carbon in the coke.	57.50	51.20	57.60	48.80	54.00	55.20	43.70	55.46	58.92	57.86	50.34
Ash	9.60	11.40	5.66	9.60	9.20	9.40	11.00	8.00	4.00	6.20	16.00
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	0.626	1.367	0.599	0.433	1.307	0.983	0.690	1.066	0.667	0.618	1.409
Character of the coke	dense.	light spongy.	spongy.	pulverulent.	spongy	spongy.	dense.	spongy.	light spongy.	dense.	dense spongy.
Color of the ash.	lt. brn'h grey.	lt. pur'h grey.	lt. brn'h grey.	nearly white.	greyish-brown.	lt. pur'h grey.	lt. grey-brown.	lilac-grey.	lt. red'h grey.	lt. lilac-grey.	lilac-grey.

Except Nos. 2741, 2735 and 2742, these Leslie county coals contain more than a good average proportion of ash material, these three, the best of all, giving, severally, only 4.00, 5.66 and 6.20 per cent. of ash; contain, severally, 94.60, 92.62 and 92.00 per cent. of total combustible matters, including small proportions of sulphur. The ash proportion in the other eight coals varies from 8 per cent. in No. 2740 up to 16 per cent. in No. 2743. By adding together the volatile combustible matters and fixed carbon in the coke, it will be seen that the total combustible matters in these eight coals varies from 81.00 in No. 2736 to 90.40 per cent. in No. 2740. So that the worst of all contains 81 per cent. of combustible matters, including 0.433 per cent. of sulphur. It may be stated, however, that the sample of this particular coal was from the very much weathered outcrop of the bed, and contained as much as 9.40 per cent. of moisture, and that this, as well as the other coals which had been weathered, will be found much better taken deeper in the bed.

It will be noticed that those coals which have the greatest proportions of ash materials have also the largest percentage of sulphur, generally speaking. The cannel coal No. 2739 is to be distinguished by its largest proportion of volatile combustible matters. Coals with large proportions of ash material are not available for the manufacture of good coke; but cannel coals, although containing large proportions of ash materials, may yet be available in gas manufacture because of their large proportions of volatile combustible matters.

LETCHER COUNTY.

COALS.

No. 2744—COAL. *Right Hand Branch of Right Hand Fork of Collier's creek, 4 miles above its mouth. Two hundred and sixty feet above a limestone. Forty-one inches of coal on 2 inches of cannel shale.* Collected by R. C. B Thruston.

A badly weathered outcrop sample; a somewhat mixed splint coal.

No. 2745—COAL. *Wilson Lewis', Roland's Branch of Poor Fork of Cumberland river. Average sample collected for coking.* By R. C. B. Thruston.

COMPOSITION OF THESE LETCHER COUNTY COALS.

(Air Dried.)

Number in Report.	2744	2745
Hygroscopic moisture	2.40	1.40
Volatile combustible matters	32.60	33.40
Coke	65.00	65.20
Totals	100.00	100.00
Total volatile matters	35.00	34.80
Fixed carbon in the coke	62.44	59.08
Ash	2.56	6.12
Totals	100.00	100.00
Percentage of sulphur	0.492	1.426
Character of the coke	dense friable.	spongy.
Color of the ash	lt. salmon-colored.	light grey.

Both good coals. The weathered sample does not probably represent the entire character of the coal deeper in the bed, where it would contain less hygroscopic moisture and more sulphur. The analysis of the coke made from coal No. 2745 is given below.

No. 2746—COKE (No. 22). *From Wilson Lewis' coal* (No. 2745), *Roland's Branch of Poor Fork. Seventy-two hour coke. Made at Quinnimont, West Virginia.* R. C. B. Thruston.

COMPOSITION. (Air Dried.)

Moisture expelled at red heat	0.70
Fixed carbon	89.30
Light grey-brown ash	10.00
	100.00
Percentage of sulphur	0.863

The percentage of ash is somewhat above good average, but not excessive.

MARSHALL COUNTY.

SOILS.

No. 2747—VIRGIN SOIL *of Crawfish Flats of Tennessee River Valley*, 2 *miles below the mouth of Jonathan creek. Sample taken to the depth of* 8 *inches Growth: hickory and red and post oaks and sassafras.* Collected by R. H. Loughridge.

Dried soil in friable clods of a dirty light grey-buff color, with dark infiltrations. The coarse sieve* separated from it about 8.2 per cent. of fine shot-iron ore. Its siliceous residue, from digestion in acids, all passed through the fine sieve† except 0.15 per cent. of fine hyaline sand.

No. 2748—SUBSOIL *of the next preceding soil, etc.*

Color somewhat lighter than that. Clods firmer. All passed through the coarse sieve except about 3.9 per cent. of shot-iron ore. Its siliceous residue passed through the fine sieve, except 3.15 per cent. of fine white sand.

No. 2749—VIRGIN SOIL *from bottom land of East Fork of Clark's river, near Benton. Sample taken* 10 *inches deep. Growth: mostly white oak. Soil: crawfishy.* Collected by R. H. Loughridge.

The dried soil, in friable clods, is of a dark buff-grey color. The coarse sieve separated from it about 5.8 per cent. of shot-iron ore. Its siliceous residue left 3.725 per cent. of fine white sand on the fine sieve.

No. 2750—VIRGIN SOIL *of Post Oak Flats of Clark's river, north of Stringtown. Sample taken to the depth of* 12 *inches. Crawfishy in character. Growth: post oak chiefly.*

The coarse sieve removed from it about 4 per cent. of shot-iron ore. Its siliceous residue left 1.05 per cent. of fine white sand on the fine sieve.

No. 2751—VIRGIN SOIL. *Dark sandy loam from low ridge of Tennessee River Valley*, 2 *miles below the mouth of Jonathan creek. Sample taken to the depth of* 12 *inches.*

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*Coarse sieve has 64 meshes to the centimeter square.

†Fine sieve has 1600 meshes to the centimeter square.

Growth: white and Spanish oaks and dogwood. Collected by R. H. Loughridge.

Dried soil in moderately firm clods of a light grey-brown color. All passed through the coarse sieve except about 0.4 per cent. of shot-iron ore. The fine sieve separated from its siliceous residue 1.5 per cent. of fine white sand.

No. 2752—VIRGIN, CRAWFISHY OR GLADY SOIL *of Tennessee Valley,* 1 *mile north of Calvert City. Sample taken to the depth of* 10 *inches.* Collected by R. H. Loughridge.

Dried soil, in pretty firm clods, of a grey-buff color. All passed through the coarse sieve except small fragments of sassafras roots and a little shot-iron ore. The fine sieve removed from its siliceous residue 1.825 per cent. of fine white sand.

No. 2753—VIRGIN LOAM SOIL *of low ridge of Tennessee River Valley,* 1 *mile north of Birmingham. Sample taken to the depth of* 12 *inches. Growth: oak and sassafras.* Collected by R. H. Loughridge.

Dried soil, in moderately firm clods, of a light grey-brown color. All passed through the coarse sieve except a small angular fragment of red jasper and a few grains of shot-iron ore. Only a few grains of fine sand were separated from the siliceous residue by the fine sieve.

No. 2754—FLATWOOD VIRGIN SOIL, *four miles south-west of Benton, on the Harvey road. Sample taken to the depth of* 8 *inches. Growth: red and white oaks, hickory and sassafras.* Collected by R. H. Loughridge.

Dried soil, with friable clods, of a light grey-brown color. All passed through the coarse sieve except a very small quantity of shot-iron ore and vegetable debris. Insoluble silicates all passed through the fine sieve.

No. 2755—SUBSOIL *of the next preceding. Sample taken at the depth of from* 8 *to* 14 *inches.* Collected by R. H. Loughridge.

Dried soil in moderately firm clods, of a light grey-brown color. All passed through the coarse sieve. Its siliceous residue all passed through the fine sieve.

No. 2756—White Silty Soil. *Middle Fork of Clark's river. Quaternary.* Collected by R. H. Loughridge.

Dried soil of a light grey-buff color. All passed through the coarse sieve except about 0.44 per cent. of shot-iron ore and ferruginous sandstone. The fine sieve separated only a very small quantity of fine white sand from its siliceous residue.

No. 2757—Bottom Soil *of West Fork of Clark's river, near Brewer's old mill. Sample taken to the depth of* 10 *inches. Growth: exclusively beech. Rich yellow loam soil.* Collected by R. H. Loughridge.

Dried soil of a grey-brown color. Clods moderately firm. All passed through the coarse sieve except a very small quantity of shot-iron ore.

COMPOSITION OF THESE MARSHALL COUNTY SOILS.

(Calculated Dried at 212° F.)

Number in Report.	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757
Organic and volatile matters	3.443	2.373	3.757	3.845	3.467	3.506	4.411	2.949	2.330	2.129	3.394
Alumina and manganese oxide	3.303	5.021	3.706	4.628	4.875	3.080	4.448	3.671	4.087	3.875	3.248
Iron peroxide	1.955	2.630	1.360	3.089	2.832	2.087	3.895	2.077	2.667	2.980	1.764
Lime carbonate	.025	trace.	.026	.076	.046	trace.	trace.	.046	.046	.045	.146
Magnesia	.162	.139	.143	.181	.194	.281	.344	.226	.827	.309	.180
Phosphoric acid ($P_2 O_5$)	.136	.110	.109	.127	.118	.110	.094	.046	.014	not est.	.084
Potash extracted by acids	.047	.515	.083	.477	.192	.305	.160	.117	.079	179	.172
Soda extracted by acids	not est.	not est	.210	.084	not est.	.046	not est.	not est.	.048	not est.	not est.
Water expelled at 380° F.	.607	.227	.588	.224	.581	.509	.557	.974	.794	.341	1.028
Sand and insoluble silicates	90.217	88.877	90.070	87.057	88.460	89.648	86.678	89.452	89.453	88.884	89.757
Totals	99.895	99.892	100.047	99.733	100.210	99.467	100.087	99.558	99.795	99.192	99.773
Hygroscopic moisture	1.300	1.100	1.520	1.800	1.225	1.900	1.400	1.300	1.300	1.850	1.300
Potash in siliceous residue	1.544	0.515	1.488	1.284	1.600	1 506	1.614	1.484	1.462	1.631	1.604
Soda in siliceous residue	1.418	.153	.402	.526	.393	.312	.598	.542	.430	.686	.699
Sand	0.150	3.150	3.725	1 050	1.500	1.825	trace.	0	0	trace.	not est.
Character of the soil	Virgin.	Subsoil.	Virgin.	Virgin.	Virgin.	Virgin.	Virgin.	Virgin.	Subsoil.	Silty.	Bottom.

All of these Marshall county soils are very deficient in lime except No. 2757, which contains only 0.146 per cent., which may be considered rather below a good average proportion. They would no doubt all be benefited by top-dressings of lime. Several of them only gave mere traces of this essential element of vegetable food.

Potash is deficient in Nos. 2747, 2749 and 2755, but is in quantity above a good average in Nos. 2748, 2750 and 2752, and in good average proportions in the rest of the soils.

Phosphoric acid is somewhat below average proportions in Nos. 2753 and 2757, and very deficient in Nos. 2754 and 2755.

All these deficiencies could be supplied by the application of appropriate commercial fertilizers or otherwise, and then even the worst of these soils could be made and kept fertile, with good husbandry, if they are sufficiently drained; they being all light and porous, made up of very finely divided earthy materials, without any coarse sand or gravel.

No. 2758—WHITE SAND. *Cretaceous. North bank of Clark's river, 2 miles north of Benton, Marshall county.* Collected by R. H. Loughridge.

A fine-grained sand; white, with a slight tinge of yellowish. Contains small mica specks. It all passed through the coarse sieve. Its insoluble residue, after digestion in acids, is mostly fine white hyaline quartz sand, containing some small mica scales.

COMPOSITION OF THIS MARSHALL COUNTY SAND.

(Calculated Dried at 212° F.)

Organic and volatile matters	0.395
Alumina, iron oxide, etc.	.323
Lime carbonate	a trace.
Magnesia	.017
Phosphoric acid (P_2O_5)	.093
Potash extracted by acids	.189
Soda extracted by acids	. . . . .
Water expelled at 400° F.	.051
Sand, etc.	98.989
	100.057
Hygroscopic moisture	0.050
Potash in siliceous residue	.001
Soda in siliceous residue	.001

This sand might be made useful in glass-making and in tempering tough clays for refractory pottery or fire-bricks.

MARSHALL COUNTY.

CLAYS.

No. 2759—CLAY. *Burradell's. Five miles north of Benton.* Collected by R. H. Loughridge.

Dried clay of a light grey color. Sandy. Infusible before the blow-pipe. Calcines hard. Washed in water, left 70.33 per cent. of fine whitish sand, containing small mica scales.

No. 2760—CLAY *from Gray's place, near Scale, Marshall county.* Collected by R. H. Loughridge.

A whitish clay, with a little yellow ochre in spots and layers. Before the blow-pipe it fused light-colored. Contains no sand.

No. 2761—ASH-COLORED EARTH *from a cistern on the old Winter's place,* 8 *miles south-east of Olive Post-office.* (Of what value is it?) Collected by R. H. Loughridge.

Nearly white. Infusible before the blow-pipe. Calcines white and hard. Washed in water, left about 33.7 per cent. of light grey sand.

No. 2762—CLAY. *Banks of Tennessee river, at Highland. Geological position, Port Hudson.* Collected by R. H. Loughridge.

Of a light grey-brown color. Contains some small blue specks (iron phosphide), scantily diffused. Fuses before the blow-pipe. A similar clay, with blue particles of iron phosphide (*Vivianite*), is described under McCracken county, No. 2781, which gave decided reaction of phosphoric acid.

No. 2763—PIPE-CLAY. *J. T. Pugh's place,* 2 *miles east of Palma. Tertiary formation.* Collected by R. H. Loughridge.

Of very light brownish-grey color. Contains minute mica specks. Before the blow-pipe it fuses with great difficulty.

No. 2764—DECOMPOSING WHITE CHERT *of siliceous Subcarboniferous limestone,* 4 *miles west of Birmingham, on Mrs. Lou. Stone's place.* Collected by R. H. Loughridge.

COMPOSITION OF THESE MARSHALL COUNTY CLAYS.

(Air Dried.)

Number in Report.	2759	2760	2761	2762	2763	2764
Silica	84.580	52.580	91.580	60.980	62.920	93.700
Alumina	10.650	31.070	5.980	18.480	29.880	3.580
Iron peroxide.	.330	1.510	.220	7.500		
Lime.	.137	.137	.045	.780	trace.	trace.
Magnesia	.101	.245	.055	1.128	.209	.127
Potash	.954	1.775	.094	2.264	1.564	.618
Soda	.292	.318	.032	.627	.172	.117
Water, etc..	2.956	12.365	1.994	7.841	5.255	1.858
Totals	100.000	100.000	100.000	100.000	100.000	100.000
Sand	70.330	0	33.700	not est.	not est.	0

These clays are all quite refractory, except No. 2762, which melts comparatively easy before the blow-pipe, and No. 2760, which fuses with difficulty. This latter clay would serve for the manufacture of white pottery ware. The first named could be used for colored terra-cotta, etc. No 2763 is quite a refractory white clay, and Nos. 2761 and 2764, the latter designated as decomposing chert or hornstone, and the former being of a similar origin probably, are both remarkable because of their very large proportions of silica, which is so very finely divided that they possess the plastic property of clay, and calcine hard. They could probably be utilized as scouring materials, in the form called Bath bricks, or otherwise. They are very refractory. They are more properly designated siliceous earths than clays.

MARTIN COUNTY.

COALS.

No. 2765—COAL. *Head of Scafford's Lick Branch of Rockcastle creek, on land of the Rockcastle Mining and Lumber Company. Sampled for analysis by R. C. B. Thruston from the section of the bed exhibited at the New Orleans Exposition. Collected by G. M. Hodge from above the 26-inch parting.*

A somewhat weathered sample of pure-looking splint coal.

No. 2766—Coal *from the same bed section. Collected by G. M. Hodge. Sampled from the part below the 26-inch parting.* By R. C. B. Thruston.

Apparently more weathered than the preceding. Splint coal, showing fibrous coal, but no apparent pyrites, between its thin laminæ. Much of the sample is in a pulverulent condition.

COMPOSITION OF THESE MARTIN COUNTY COALS.

(Air Dried.)

Number in Report.	2765	2766
Specific gravity	1.344	1.451
Hygroscopic moisture	2.92	2.62
Volatile combustible matters	34.98	27.98
Coke	62.10	69.40
Totals	100.00	100.00
Total volatile matters	37.90	30.60
Fixed carbon in the coke	55.30	50.40
Ash	6.80	19.00
Totals	100.00	100.00
Percentage of sulphur	0.681	0.736
Character of the coke	dense spongy.	friable.
Color of the ash	light buff.	light grey.

The coal of the upper portion, with its 6.80 per cent. of ash, contains 90.28 per cent. of combustible matters, including its sulphur, while that of the lower seam contains only 78.38 per cent., with its 19 per cent. of ash. This latter coal would not bear long transportation. Both samples seem to show weathering, and it is probable that deeper in the bed the coal will be found to be somewhat purer.

McCRACKEN COUNTY

SOILS.

No. 2767—Soil (virgin). *Oak and Hickory Flatlands. Albert Bradshaw's land, south-west of Paducah. Sample taken to* *the depth of* 8 *inches. Timber: white and red oaks, hickory, dogwood and sassafras.* Collected by R. H. Loughridge.

Dried soil of a brownish-grey color. Clods friable. All passed through the coarse sieve* except a small quantity of vegetable debris. Its siliceous residue, from digestion in acids, all passed through the fine sieve† except a very small quantity of very fine hyaline sand.

No. 2768—SUBSOIL *of the next preceding. Sample taken at the depth of* 8 *to* 15 *inches.* Collected by R. H. Loughridge.

Dried subsoil of a lighter color than the surface soil, and more yellowish. Its small clods were firm. All passed through the coarse sieve except a small quantity of vegetable debris. Its siliceous residue passed through the fine sieve except 2.75 per cent. of fine white quartz sand.

No. 2769—VIRGIN SOIL. *Brown loam. New Hope Church. South-west corner of McCracken county. Sample taken to the depth of* 6 *inches. Timber: white and red oaks, hickory, dogwood and sassafras.* Collected by R. H. Loughridge.

Dried soil of a light grey-brown color. Clods friable. All passed the coarse sieve* except a small portion of vegetable debris. Its siliceous residue, from digestion in acids, all passed through the fine sieve† except a few small grains of hyaline quartz sand.

No. 2770—SUBSOIL *of the next preceding. Taken at the depth of from* 6 *to* 12 *inches.* Collected by R. H. Loughridge.

Dried subsoil of a grey-buff color. Clods friable. All passed through the coarse sieve except a little shot-iron ore and a small quartz pebble. Its siliceous residue passed through the fine sieve.

No. 2771—VIRGIN SOIL *of Red Oak Barrens,* 4 *miles east of Woodville. Sample taken to the depth of* 8 *inches. Growth: red oaks,* 10 *to* 15 *feet high.* Collected by R. H. Loughridge.

Dried soil of a grey-brown color. Clods friable. All passed through the coarse sieve. The fine sieve separated a small quantity of fine hyaline quartz sand from its siliceous residue.

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* Of 64 meshes to the centimeter square.

† Of 1600 meshes to the centimeter square.

No. 2772—SUBSOIL *of the next preceding. Taken from* 8 *to* 12 *inches deep.* Collected by R. H. Loughridge.

Dried subsoil of a brownish-buff color. Lighter colored than the preceding. Clods friable. The coarse sieve removed from it 3.6 per cent. of shot-iron ore. All its siliceous residue passed through the fine sieve except a few small grains of quartz sand.

No. 2773—VIRGIN SOIL *of Post Oak Flatwoods,* 1 *mile west of Paducah, on Hinkleville road. Taken* 10 *inches deep. Growth: chiefly post oak, a little red oak and hickory.* Collected by R. H. Loughridge.

No. 2774—SUBSOIL *of the next preceding. Sample taken from* 10 *to* 14 *inches deep.* Collected by R. H. Loughridge.

Dried subsoil, yellowish-grey. Clods quite friable. The coarse sieve removed from it 3.1 per cent. of shot-iron ore. Its siliceous residue all passed through the fine sieve except a small quantity of fine white sand.

No. 2775—VIRGIN SOIL. *Fine silty ash-colored soil of the Post Oak Flatwoods, near the county line, north of Woodville. Sample taken to the depth of* 8 *inches. Growth: post and red oaks.* Collected by R. H. Loughridge.

Dried soil of a light grey or ashy color. Clods friable. All passed through the coarse sieve except 7.1 per cent. of shot-iron ore. Its siliceous residue all passed through the fine sieve.

No. 2776—SUBSOIL *of the next preceding. Taken* 6 *to* 12 *inches below the surface.* Collected by R. H. Loughridge.

Dried subsoil, very light grey. Its small clods are somewhat firm. The coarse sieve separated from it 5.4 per cent. of shot-iron ore. Its siliceous residue all passed through the fine sieve except a few grains of fine sand.

COMPOSITION OF THESE McCRACKEN COUNTY SOILS.

(Calculated Dried at 212° F.)

Number in Report.	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776
Organic and volatile matter . .	4.385	3.781	3.549	2.365	3.863	2.335	2.807	2.309	2.088	1.637
Alumina and manganese oxide .	7.307	6.578	3.160	3.339	4.089	4.941	5.336	4.982	2.818	3.295
Iron peroxide.	3.094	3.416	1.681	1.880	2.763	2.883	3.086	3.441	1.533	1.950
Lime carbonate.	.215	.164	.197	.121	.184	.097	.127	.097	.171	.161
Magnesia	.046	.047	.327	.289	.220	.290	.394	.327	.161	.235
Phosphoric acid (P_2O_5). . . .	.110	.085	.096	.078	.121	.095	.095	.079	.062	.080
Potash extracted by acids . . .	.271	.227	.329	.282	.190	.216	.167	.302	.179	.125
Soda extracted by acids	.119	.032	.583	not est.	.302	.168	.087	not est.	.145	not est.
Water expelled at 400° F. . . .	.909	.488	.547	.379	.662	.885	.946	.761	.538	.463
Sand and insoluble silicates . .	83.233	84.790	90.050	91.147	88.033	88.309	87.213	87.476	92.726	92.642
Totals	99.689	99.608	100.519	99.880	100.877	100.219	100.258	99.774	100.416	100.538
Hygroscopic moisture	2.750	2.825	1.265	1.100	1.655	1.500	1.500	1.700	0.875	1.050
Potash in siliceous residue . . .	1.215	1.343	1.621	1.467	1.513	1.252	1.428	1.435	1.446	1.566
Soda in siliceous residue	.480	.500	1.050	.753	.518	.167	.704	.718	1.062	1.219
Character of the soil	Virgin.	Subsoil.	Virgin.	Subsoil.	Virgin.	Subsoil.	Virgin.	Subsoil.	Virgin.	Subsoil.

No. 2767 contains an average proportion of organic and volatile matters, as well as good percentages of the other essential elements, with the one exception of magnesia. This is not likely, however, to prevent it from being a quite fertile soil, if the physical conditions, drainage, etc., are favorable. All the others, except No. 2771, contain less than a good average of phosphoric acid. Nos. 2775 and 2776 are especially deficient in this essential ingredient. Phosphatic fertilizers would be beneficial to all these, and especially to the latter mentioned soils. Lime is generally present in good average proportions, except in subsoils Nos. 2772 and 2774, and potash is in ample proportions in all. These soils are all composed of very finely divided materials, none of them containing any gravel or coarse sand. They ought all to be productive, with good management and economy of manures, if well drained, and the other physical conditions are favorable.

McCRACKEN COUNTY CLAYS.

No. 2777—CLAY. *Mr. Jones', 3 miles south of Paducah.* Collected by R. H. Loughridge.

Dried clay of a light grey color. Fused with difficulty before the blow-pipe. Calcined white.

No. 2778—CLAY *on John Mitchell's place, 3 miles east of Lovelaceville.* Collected by R. H. Loughridge.

Dried clay of a light brownish-grey color. Fused grey before the blow-pipe.

No. 2779—GYPSEOUS CLAY *from Mr. W. J. Hough's place, 4 miles west of Paducah.* Collected by R. H. Loughridge.

Dried clay, nearly white, with ferruginous stains in spots. Contains a very small proportion of sand. Fuses slightly before the blow-pipe. Calcines white.

No. 2780—BLUE MICACEOUS CLAY. *Tertiary; on Armstrong's place, 7 miles east of Paducah.* Collected by R. H. Loughridge.

Dried clay of a grey color. Contains minute specks of mica. Before the blow-pipe it fuses grey.

No. 2781—**Blue Micaceous Clay**, *charged with blue particles of Vivianite.* (See No. 2762 for a similar clay in Marshall county.) Collected by R. H. Loughridge.

Darker colored than the preceding; 56.60 per cent. of brownish sand, containing small mica scales, was washed out of it. The blue specks gave a marked reaction of phosphoric acid. Before the blow-pipe this clay fused grey.

COMPOSITION OF THESE McCRACKEN COUNTY CLAYS.

(Air Dried.)

Number in Report.	2777	2778	2779	2780	2781
Silica	59.500	66.320	67.580	69.220	78.192
Alumina	24.960	22.930	20.040	17.540	16.540
Iron peroxide	.720	1.190	.540	1.440	1.840
Lime	.325	.437	1.748	.437	.369
Magnesia	.396	.209	.158	.858	.461
Potash	1.934	1.107	1.340	2.452	1.969
Soda	.286	.470	.075	.472	.541
Water, etc.	11.879	7.337	8.524	7.581	5.088
Totals	100.000	100.000	100.000	100.000	100.000
Sand . . . . {	not est.	not est.	small proportion.	50.580	56.600

Nos. 2777 and 2779 are good plastic clays, suitable for the manufacture of white or whitish pottery ware. They are also quite refractory. Nos. 2778 and 2780, containing more iron peroxide, are rather less refractory, and calcine somewhat colored.

The large proportions of fine sand in Nos. 2780 and 2781 somewhat diminishes their plasticity, and their considerable percentages of iron peroxide and potash renders them fusible at a high temperature. Possibly very fine sand exists in some of the others, not easily removed by washing.

The Vivianite in No. 2781 is in too small quantity to make it available for phosphatic manure. No. 2778 contains some of its lime in the form of sulphate, but not in large proportion.

OLDHAM COUNTY.

No. 2782—MINERAL WATER *from Anita Springs, residence of Dr. G. T. Berry,* 1 *mile from Lagrange. Flows from the cavernous layer of the Clinton Group of the Upper Silurian.* Collected by W. M. Linney, September, 1885.

The water is transparent, colorless and inodorous. On evaporation it left 0.274 of a gramme of *saline matters* to the litre (about 1,000 grammes) of the water. These consist mainly of carbonates of lime and magnesia, sulphates of potash and soda, chloride of magnesium and silica. It is a pure weak saline water.

PERRY COUNTY COALS.

No. 2783—COAL. *Sixty-one inches. John Fields'. Sampled by John T. Proffit from the lower* 36 *inches.* Collected by G. M. Hodge.

A weathered sample of splint coal. Some fibrous coal between the thin laminæ, but no appearance of pyrites. Some ferruginous incrustation.

No. 2784—CANNEL COAL. *Ten inches* (in the same bed 24 inches of bituminous coal), 1 *mile below Rush Branch, Middle Fork Kentucky river.* Collected by G. M. Hodge.

A somewhat weathered sample. Ferruginous incrustation on some of the surfaces.

No. 2785—COAL. *Forty-four inches. William Boling's, Rush Branch of Middle Fork of Kentucky river. Sample of the upper* 20 *inches.* Collected by G. M. Hodge.

A pure-looking coal. No apparent pyrites. Some little fibrous coal.

No 2786—COAL *Sample of the lower* 20 *inches of the same bed as the above. Resembles that coal, but is somewhat brighter.*

No. 2787—COAL. *Fifty-six inches. Abner Campbell's. Fish Trap Branch of North Fork of Kentucky river.* Collected by G. M. Hodge.

Some portions dull, like cannel coal; others bright. Some fibrous coal between the laminæ, but no apparent pyrites.

No. 2788—COAL. *Forty-five inches. Thomas J. Johnson's, Ebersole Branch of Middle Fork of Kentucky river.* Collected by G. M. Hodge.

Apparently a splint coal, somewhat weathered. Some fibrous coal between the laminæ, but no apparent pyrites.

No. 2789—COAL. *Fifty two inches. John Spencer's, Grape-vine creek. Sample of the lower* 48 *inches.* Collected by G. M. Hodge.

Generally dull black. Fibrous coal and some little granular pyrites between the laminæ. Some portions of bright pitch-black.

No. 2790—COAL. *Forty-eight inches, mouth of Guy's creek, Middle Fork of Kentucky river. Sample of the upper* 32 *inches.* Collected by G. M. Hodge.

Generally dull black splint coal. Some fine fibrous pyrites and fibrous coal. Portions shining pitch-black.

No. 2791—COAL. *Forty inches. John Spencer, Grape-vine creek.* Collected by G. M. Hodge.

A somewhat weathered sample of splint coal.

No. 2792—COAL. *Thirty nine inches. Joseph Campbell's, mouth of Rock Lick Branch of North Fork of Kentucky river.* Collected by G. M. Hodge.

A weathered sample of splint coal.

No. 2793—COAL. *Thirty-nine inches. Alexander Combs', North Fork of Kentucky river,* 5 *miles below Hazard.* Collected by G. M. Hodge.

Apparently good splint or semi-bituminous coal. No apparent pyrites.

No. 2794—COAL. *Forty five inches. Samuel Whitaker's, Willard creek.* Collected by G. M. Hodge

Portions of the sample dull splint coal. Some fibrous coal between the laminæ, but no apparent pyrites. Some pieces bright pitch-black.

No. 2795—COAL. *Thirty six inches. Peter Gross'. Mine near the mouth of Squabble creek, Middle Fork of Kentucky river.* Collected by G. M. Hodge.

Generally pitch-black coal, breaking irregularly with irregular shining surfaces. A few pieces dull and laminated. No pyrites apparent, and but very little fibrous coal.

COMPOSITION OF THESE PERRY COUNTY COALS.

(Air Dried.)

Number in Report.	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795
Specific gravity	1.333	not est.	1.279	1.300	1.359	1.334	1.366	1.366	not est.	not est.	1.290	1.390	2.259
Hygroscopic moisture	3.50	0.80	1.20	1.20	5.26	3.30	4.36	3.40	6.48	2.80	1.76	3.96	1.90
Volatile combustible matters	35.30	44.80	39.60	35.90	30.34	34.90	30.34	31.00	30.32	29.60	36.04	32.84	37.10
Coke	61.20	54.40	59.20	62.90	64.40	61.80	65.30	65.60	63.20	67.60	62.20	63.20	61.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	38.80	45.60	40.80	37.10	35.60	38.20	34.70	34.40	36.80	32.40	37.80	36.80	39.00
Fixed carbon in the coke	53.14	37.60	52.70	55.30	55.20	52.20	54.90	55.30	47.80	58.50	56.20	52.80	57.10
Ash	8.06	16.80	6.50	7.60	9.20	9.60	10.40	10.30	15.40	9.10	6.00	10.40	3.10
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	1.035	0.970	1.327	0.654	0.475	0.763	0.450	0.557	0.491	0.505	0.557	0.722	0.749
Character of the coke	dense.	pulverulent.	spongy.	light spongy.	friable.	dense. friable.	friable.	friable.	pulverulent.	friable.	light spongy.	friable.	spongy.
Color of the ash	lt. brownish-grey	grey-brown	light lilac-grey.	nearly white.	lt. purlp'h-grey.	purplish-grey.	very light grey.	very light grey.	very light grey.	purplish-grey	very light grey.	purplish-grey.	lt. purp'h-grey.

Of these Perry county coals only one, No. 2784, is a cannel coal, characterized in its composition by its larger percentage of volatile combustible matters than in the other samples, which are mostly splint or semi-bituminous coals. This cannel coal gives also a larger proportion of ash than the other coals, viz: 16.8 per cent.; yet the sum of its combustible materials is 82.4 per cent. The purest of all these samples is No 2795, which gives only 3.1 per cent. of ash, and its total combustible matters amount to 95.0 per cent. As can be seen, several of these coals contain more than a good percentage of ash, which, however, will not prevent them from being valuable for all ordinary purposes, although not so available for making good coke as others which contain less earthy material. The sulphur percentage in these coals is generally moderate.

PULASKI COUNTY COALS.

No. 2796—COAL. *Barren Fork. The run of the mine. Sample of the coal taken for coking two years ago.* By R. C. B. Thruston.

No. 2797—COAL *of the Barren Fork Coal and Mining Company. Nut coal. Average sample of the coal taken for coking two years ago.* By R. C. B. Thruston

COMPOSITION OF THESE PULASKI COUNTY COALS.

(Air Dried.)

Number in Report	2796	2797
Hygroscopic moisture	2.32	2.12
Volatile combustible matters	32.48	31.56
Coke	65.20	66.32
Totals	100.00	100.00
Total volatile matters	34.80	33.68
Fixed carbon in the coke	59.10	59.02
Ash	6.10	7.30
Totals	100.00	100.00
Percentage of sulphur	1.077	1.879
Character of the coke	spongy.	spongy.
Color of the ash	light grey.	yellowish-grey.

Pretty good coals, containing 91.58 and 90.58 per cent. of total combustible matters severally. The ash and sulphur percentages are somewhat above a very good average for coking purposes.

WARREN COUNTY.

No. 2798—MARL *from near the bottom of the Saint Louis limestone beds, near Bowling Green, about* 100 *feet above Barren river. Sample from the top, middle and bottom of a* 4 *foot bed. Average sample.* Collected by M. H. Crump, Civil Engineer, April 30, 1885.

Of a light grey color, portions with ferruginous stains. Plastic with water. Powder of a light buff color. Calcines nearly white, with a light reddish tint.

COMPOSITION. (Air Dried.)

Silica	28.780
Alumina	11.681
Iron peroxide	2.960
Lime carbonate	43.760
Magnesia carbonate	6.320
Phosphoric acid (P_2O_5)	.249
Potash	2.124
Soda	not est.
Moisture and loss	4.176
	100.000

This marl would be beneficial as a top-dressing to light sandy soil which is deficient in lime. It could also be, no doubt, converted into water cement of the character of Portland cement, by proper admixture with more lime and calcination.

This marl may be said to contain a little more than 43 per cent. of clay (exclusive of moisture), and nearly 44 per cent. of carbonate of lime. Good artificial Portland cement is said to be made, in England, etc., from a mixture of 21 to 23 per cent. of clay, and 79 to 77 per cent. of chalk (which is nearly pure carbonate of lime). Ground limestone could be used, and the best proportions found by actual experiment.

No. 2798*a*—MINERAL WATER, *from a bored well* 502 *feet deep; beginning about the middle of the St. Louis lime-*

stone. Bored by Captain Smallhouse. Sample sent by M. A. Crump, Civil Engineer, Bowling Green.

The water, contained in a stoneware jug, was turbid with a yellowish material. Smelt strongly of hydrogen sulphide and petroleum; a little of the latter substance floating on it.

Qualitatively examined, it was found to contain chlorides, sulphates and sulphides of magnesium, calcium, sodium, &c. Its total *solid saline matters* is 5.09 per cent., most of which is sodium chloride—common salt. A pretty strong saline sulphur water

WHITLEY COUNTY COALS.

No. 2799—COAL. *Possum Branch of Wolf creek.* Collected by A. R. Crandall. *Three feet of coal, under a sandstone ledge; on farm of Joseph Cox.*

A bright, pure-looking coal, showing very little fibrous coal, and no apparent pyrites.

No. 2800—COAL. *Forks of Jellico creek. Jellico Creek Salt Works, at R. P. Crickmore's. Upper* 38 *inches of the main coal.* Sample collected by A. R. Crandall.

A bright, pure-looking sample; fracture generally shining and somewhat irregular. Some few thin scales of bright pyrites, but very little fibrous coal apparent. Contains a few pieces of lamellar structure and dull appearance.

No. 2801—COAL. *Right Fork of Bennett's creek. Coal* 48 *inches thick. Sample from the whole thickness, without parting.*

A block coal or splint. Mostly bright, pure-looking coal, of irregular, shining fracture. A small portion more dull, and lamellar in structure. No pyrites or fibrous coal apparent.

No. 2802—COAL. *Right Fork of Patterson creek. Pleasant Palley's coal. Fifty-two inches thick. Sample from the whole bed.* Collected by A. R. Crandall.

A pure-looking coal, breaking generally with irregular fracture and shining surfaces; some pieces showing "bird's-eye" fracture with satiny lustre. A small portion lamellated. Hardly any fibrous coal and no pyrites apparent.

No. 2803—COAL. *Briar creek. W. Jones' coal,* 28 *inches thick. Sample from the whole face of the bed.* Collected by A. R. Crandall.

Apparently a pure splint or block coal. No pyrites, and but little fibrous coal apparent.

No. 2804—COAL. *Briar creek. Henry Green's coal,* 3 *feet thick. Sample from the whole thickness, from* 20 *feet in the entry.* Collected by A. R. Crandall.

A pure-looking, pitch-black coal, breaking generally with shining, irregular surfaces. But little fibrous coal and no pyrites apparent.

No. 2805—COAL. *Briar creek. Richardson's coal,* 36 *inches thick without parting. Average sample from the whole face.* Collected by A. R. Crandall.

Quite a pure-looking coal, of the character of the next preceding.

No. 2806—COAL. *Head of Little Patterson creek. M. A. Jones' coal. Average thickness,* 3 *feet without parting.* Collected by A. R. Crandall.

Quite a pure-looking, pitch-black coal, breaking with irregular shining surfaces. Portions lamellated with some fibrous coal, but no apparent pyrites.

No. 2807—COAL. *Tackett's creek. Main coal. Terrel Siler's. Two miles from the mouth, and half a mile above Mr. Siler's house. Bed* 41 *inches thick, with a half-inch parting* 16 *inches from the bottom.* Sample collected by A. R. Crandall.

Resembles the preceding.

No. 2808—COAL. *Mahan Station. Average sample of the upper* 23 *inches.* (A parting of 5 inches.) Sample collected by A. R. Crandall.

Coal resembles the preceding.

COMPOSITION OF THE TEN PRECEDING WHITLEY COUNTY COALS.

(Air Dried.)

Number in Report.	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808
Specific gravity	1.308	1.285	1.282	1.279	1.271	1.281	1.414	1.262	1.277	1.321
Hygroscopic moisture	1.84	2.00	2.40	2.14	1.90	1.90	1.94	2.14	2.40	2.20
Volatile combustible matter	33.84	31.30	35.80	39.76	36.10	37.40	38.92	36.06	36.60	33.10
Coke	64.32	66.70	61.80	58.10	62.00	60.70	59.14	61.80	61.00	64.70
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	35.68	33.30	38.20	41.90	38.00	39.30	40.86	38.20	39.00	35.30
Fixed carbon in the coke	59.96	62.94	58.96	55.06	59.50	58.60	56.84	59.20	57.70	56.80
Ash	4.36	3.76	2.84	3.04	2.50	2.10	2.30	2.60	3.30	7.90
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	2.180	0.901	0.556	0.892	0.997	0.928	0.764	0.755	0.708	4.234
Character of the coke	light spongy.	light spongy.	light spongy.	light spongy.	spongy.	spongy.	spongy.	spongy.	dense spongy.	light spongy.
Color of the ash	lilac.	white.	lt. br'n'h grey.	lt. br'n'h grey.	lt. br'n'h grey.	lt. br'n'h grey.	lt. br'n'h grey.	lt. br'n'h grey.	lt. br'n'h grey.	dark purplish.

Most of these are remarkably pure coals, their ash percentages extending from 2.10 per cent. in No. 2804 up to 7.90 in No. 2808. This latter is exceptional, not only in its much greater ash proportion, but in the extraordinary amount of sulphur it contains, viz: 4.234 per cent. This must have been present in the sample as very fine granular iron pyrites, as was rendered probable by the large amount of iron contained in its ash. Its total combustible matters, including the sulphur, is 89.9 per cent.

No. 2804 contains 96 per cent. of combustible matters, with its 2.1 per cent. of ash.

The ash proportions vary, in the other samples, from 3.76 down to 2.30 per cent. These are all, except No. 2808, remarkably good, pure coals, and no doubt would make very good coke. As several of them are somewhat soft coals, approaching so-called bituminous coals, their coke may be light and spongy unless made under pressure.

WHITLEY COUNTY COALS—Continued.

No. 2809—COAL. *Mahan's coal. Mahan's Station; eighteen inches below the parting. Average sample.* Collected by A. R. Crandall.

Resembles the next preceding.

No. 2810—COAL. *W. M. Mahan's coal. Mahan's Station. Eighteen inches of the bottom;* 13 *inches of the top, with a* 5*-inch parting. Average sample of the whole bed.* Collected by A. R. Crandall.

A pure looking, pitch-black coal; breaking with shining irregular surfaces. Very little fibrous coal, and no pyrites apparent.

No. 2811—COAL. *Caddell's. Wolf creek. Bed* 37 *inches thick, with a slight parting. Sample from near the outcrop.* Collected by A. R. Crandall.

A somewhat weathered sample of what appears to be a good coal.

No. 2812—COAL. *Thomas' cannel coal. Head of Left Fork of Wolf creek. Splint coal, with some cannel at the bot-*

tom. Twenty-six inches near the outcrop. Sample collected by A. R. Crandall.

A much weathered sample.

No. 2813—COAL. *Lower 26 inches of the R. P. Crickmore coal. (Upper part previously sampled.)* Collected by A. R. Crandall.

A bright, pure-looking, pitch-black coal; breaking generally with irregular shining surfaces. Very little fibrous coal, and no pyrites apparent.

No. 2814—COAL. *B. P. Shelby's. Upper 22 inches.* Collected by A. R. Crandall.

A pure-looking sample of what seems to be a splint coal. But little fibrous coal, and no pyrites apparent.

No. 2815—COAL. *Wagner Siler's. On Mud Creek. Forty inches thick, without parting. Average sample from the whole face of the bed.* Collected by A. R. Crandall.

A pure-looking coal; generally breaking with irregular shining surfaces. Some portions lamellated, with some little fibrous coal, but no apparent pyrites between.

No. 2816—COAL. *J. S. Berry's. Jellico seam. Sample from coal collected two years ago for coking.* By R. C. B. Thruston.

COMPOSITION OF THESE WHITLEY COUNTY COALS.

(Air Dried.)

Number in Report.	2809	2810	2811	2812	2813	2814	2815	2816
Specific gravity	1.271	1.311	1.359	1.387	1.263	1.341	1.293	n. e.
Hygroscopic moisture	2.20	1.80	1.50	7.26	1.70	2.24	2.58	2.00
Volatile combustible matters .	34.86	36.70	40.56	33.84	37.40	35.66	33.12	34.82
Coke.	62.94	61.50	57.94	58.90	60.90	62.10	64.30	63.18
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	37.06	38.50	42.06	41.10	39.10	37.90	35.70	36.82
Fixed carbon	58.14	58.50	51.24	53.20	59.36	58.76	62.70	60.48
Ash	4.80	3.00	6.70	5.70	1.54	3.34	1.60	2.70
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	1.340	1.093	2.768	0.640	1.721	1.060	0.670	0.629
Character of the coke	spongy.	spongy.	dense spongy	pulverulent.	spongy.	light spongy.	light spongy.	light spongy.
Color of the ash.	brownish grey.	light purplish-grey.	dark greyish-purple.	grey-brown.	light purplish-grey.	salmon color.	light brown.	very light brown-grey.

These are good, and some of them very good coals. The highest ash percentage—in No. 2811—is 6.70. This approaches cannel coal in composition, and contains 91.80 per cent. of combustible matters, including 2.768 per cent. of sulphur, a large proportion of the latter.

The lowest ash proportions in these coals is in Nos. 2813 and 2815, being only 1.54 and 1.60 per cent. severally.

No. 2813 contains 96.76 per cent. of combustible matters, including 1.721 per cent. of sulphur.

No. 2815 contains 95.82 per cent. of combustible matters, including 0.670 per cent. of sulphur.

No. 2816 contains 95.30 per cent. of combustible matters, including 0.629 per cent. of sulphur.

No. 2810 contains 95.20 per cent. of combustible matters, including 1.093 per cent. of sulphur.

No. 2814 contains 94.42 per cent. of combustible matters, including 1.060 per cent. of sulphur.

No. 2809 contains 93.00 per cent. of combustible matters, including 1.340 per cent. of sulphur.

All of these six coals could no doubt be made available in the manufacture of coke. Those would, of course, be preferred which contained the least sulphur and ash. An example of the coke made from one of these (No. 2816) is given below.

No. 2817—COKE. (No. 14.) *Of J. S. Berry's coal. Jellico series. Five miles north of Williamsburg, Whitley county.*

Seventy-two hours' coke. Made at Quinnimont, West Virginia, March 20th-23d. R. C. B. Thruston.

COMPOSITION.—(Air Dried).

Moisture, etc., expelled at red heat	1.50
Fixed carbon	93.30
Light brownish-grey ash	5.20
	100 00
Percentage of sulphur	0.382

Comparing its sulphur percentage with that of the coal from which it was made, it will be seen that a large proportion of it was removed in the process of coking. This, no doubt, is the case with most coals; the quantity removed varying according to the condition or form of combination of the sulphur in the coal.

APPENDIX.

For comparison with Kentucky cokes and coking coals, a number of samples of both, of West Virginia, were collected by Mr. Thruston, the results of the analyses of which are given in the following pages:

WEST VIRGINIA COALS.

No. 2818—COAL. (Sample 11.) *Three miles above the mouth of Preacher creek, or Callahan creek, of Rolling Fork of Powell's river, Wise county. Sample of the 27-inch cannel coal of the bed.* Collected by R. C. B. Thruston.

A dull-looking cannel coal.

No. 2819—COAL. *Quinnimont Mines, Fayette county. Thickness of bed where sampled, 34 inches.* Collected by R. C. B. Thruston.

A bright, pure-looking coal. Fracture irregular, with shining surfaces. No pyrites or fibrous coal apparent.

No. 2820—COAL. *Fire creek, Fayette county.* Collected by R. C. B. Thruston.

No. 2821—COAL. *Stone Cliff, Fayette county. Upper seam, above the conglomerate; bed 4 feet 3 inches to 5 feet. Sample from the 4 feet 3 inches.* Collected by R. C. B. Thruston.

A pure-looking, pitch black coal. Somewhat laminated. Fracture generally irregular, with shining surfaces.

No. 2822—Coal. *Stone Cliff, Fayette county. Quinnimont seam. Coal 44 to 52 inches; no parting. Sample from where it measures 46 inches.* Collected by R. C. B. Thruston.

No. 2823—Coal. *Sewell, Fayette county. On top of the conglomerate. From 34 to 42 inches thick.* Collected by R. C. B. Thurston.

A pure-looking, soft coal. Irregular fracture, with shining surfaces. Fibrous coal, but no pyrites apparent.

No. 2824—Coal. *Hawksnest, Fayette county, West Virginia. Sample exclusive of parting.* Collected by R. C. B. Thruston.

A pure-looking, pitch-black coal. Fracture irregularly cuboidal, with shining surfaces. Some little fibrous coal apparent.

COMPOSITION OF THESE WEST VIRGINIA COALS.

(Air Dried.)

Number in Report.	2818	2819	2820	2821	2822	2823	2824
Hygroscopic moisture	0.86	0.40	0.60	0.60	0 90	0.80	1.06
Volatile combustible matters.	38.54	18.00	20.80	22 80	19.10	22.14	32.34
Coke	60 60	81.60	78.60	76.60	80.00	77.06	66 60
Totals	100.00	100.00	100.00	100 00	100.00	100.00	100.00
Total volatile matters	39 40	18.40	21.40	28 40	20.00	22.94	33.40
Fixed carbon	47.84	79.00	75.34	74.20	73.60	74 46	62.00
Ash	12.76	2.60	3.26	2.40	6.40	2.60	4.60
Totals	100 00	100 00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur . . .	0.711	0.491	0.418	0 491	0.848	0.464	0.629
Character of the coke	dense friable.	much inflated.	light spongy.	light spongy.	light spongy.	much inflated.	spongy.
Color of the ash	chocolate brown.	light brownish grey.	light buff-grey.	light buff-grey.	light buff-grey.	light brownish-grey.	light buff-grey.

With the exception of No. 2818, which is a cannel coal, and No. 2824, these West Virginia coals are quite remarkable because of their small proportions of volatile combustible matters, and generally small ash, as well as the very light or inflated cokes they leave when heated under the atmospheric pressure only. They also present the singular fact that their cokes are of very difficult incineration.

WEST VIRGINIA COKES.

No. 2825—COKE. *Forty-eight hours. Made at Quinnimont, of Quinnimont coal.* March 22d-24th, 1886. R. C. B. Thruston.

No. 2826—COKE. *Of Hawksnest coal, Fayette county. Made in Solendorf Coppe oven, at Quinnimont.* Collected by R. C. B. Thruston.

No. 2827—COKE. *Forty-eight hours. Of Fire creek coal, Fayette county. Made at Quinnimont.* March 26th, 1886. Collected by R. C. B. Thruston.

No. 2828—COKE. *Forty-eight hours. Of Stone Cliff coal, Fayette county. Made at Quinnimont.* Collected by R. C. B. Thruston.

No. 2829—COKE. *Forty-eight hours. Of Stone Cliff coal, Fayette county. Made at Quinnimont.* March 16th, 1886. Collected by R. C. B. Thruston.

No. 2830—COKE. *Seventy-two hours. Of Stone Cliff coal, Fayette county. Made at Quinnimont.* Collected by R C. B. Thruston.

No. 2831—COKE. *Forty-eight hours. Of Sewell coal. Made at Quinnimont.* Collected by R. C. B. Thruston.

No. 2832—COKE. *Seventy-two hours. Made of Sewell coal, at Quinnimont.* Collected by R. C. B. Thruston.

COMPOSITION OF THESE WEST VIRGINIA COKES.

(Air Dried.)

Number in Report.	2825	2826	2827	2828	2829	2830	2831	2832
Moisture expelled at red heat	2.20	0.40	1.70	0.86	0.36	1.60	0.50	1.60
Fixed carbon	92.00	90.50	92.90	92.74	96.40	89.80	92.90	91.80
Ash	5.80	9.10	5.40	6.40	3.24	8.60	6.60	6.60
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	0.491	0.711	0.401	0.437	0.519	0.821	0.560	0.478
Color of the ash	brownish-grey.	light grey-brown.	brownish-grey.	light buff-grey.	light reddish brown.	light grey-brown.	light brownish-grey.	light brown-grey.

These are, generally, quite good cokes, No. 2830 being the only one which presents ash and sulphur a little above good average proportions.

The variation in the proportions of moisture is no doubt accidental. The purest of them all is No. 2829, containing 96.40 per cent. of fixed carbon, and only 3.24 per cent. of ash, with 0.519 of sulphur.

BELL COUNTY.

COALS.

No. 2833—COAL. (Sample 1.) *On John R. Slusher's land, Left Fork of Straight creek, Bell county.* Collected by R. C. B. Thruston, June 2d, 1886.

A weathered sample, incrusted in part with ferruginous material. Sample from the upper two seams, 6 and 31 inches in thickness, severally, separated by 1 inch of shale. Another seam of 5 inches of coal, separated from these two beds by 5 inches of shale, was not sampled.

COMPOSITION.—(Air Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	1.40	Total volatile matters	38.50
Volatile combutsible matters	37.10		
Dense spongy coke	61.50	Fixed carbon in the coke	56 80
		Brown ash	5.20
	100.00		100.00
Percentage of sulphur	1.151		

A good semi-bituminous coal, containing rather more volatile combustible matters than the very best coking coal.

No. 2834—COAL. (Sample 2.) *James Green's, on the divide between Browney's and Hansee's creeks, Bell county.* Collected by R. C. B. Thruston, July 13th, 1886.

A pure-looking, pitch-black coal, generally of cuboidal structure; breaking with irregular, shining surfaces. Some portions somewhat lamellated, and of somewhat dull fracture. Very little fibrous coal, and no pyrites apparent.

This sample is of the upper seam of 38 inches, separated, in this bed, by a 20-feet space, from the lower two seams of coal.

No. 2835—Coal. (Sample 12.) *From James Green's lower bank. Sample from the 26-inch seam of coal lying 20 feet below the coal from which sample* 2 (No. 2834) *was taken, and separated from coal of sample* 13 (No. 2836) *by a 2-inch parting of shale.* Sample collected by R. C. B. Thruston, September 24th, 1886.

A pure-looking, pitch-black, hard coal, resembling the brighter, harder portions of the next preceding sample.

No. 2836—Coal. (Sample 13.) *From James Green's bank. Sample from the* 21-*inch seam lying under coal of sample* 12 (No. 2835), *and separated from that by a 2-inch layer of shale.* Collected by R. C. B. Thruston, September 24th, 1886.

A bright, pitch-black, firm coal; structure cuboidal; breaking with irregular, shining surfaces. No fibrous coal or pyrites apparent.

COMPOSITION OF THESE COALS OF JAMES GREEN'S BANK.

(Air Dried.)

Number in Report.	2834	2835	2836
Hygroscopic moisture	0.60	1.20	1.00
Volatile combustible matters	35.00	32.20	35.40
Coke	64.40	66.60	63 60
Totals	100.00	100 00	100.00
Total volatile matters	35.60	33.40	36.40
Fixed carbon in the coke	61 90	61 60	61.70
Ash	2 50	5 00	1.90
Totals	100.00	100.00	100.00
Percentage of sulphur	1 068	0.574	0.629
Character of the coke	very dense.	inflated.	inflated.
Color of the ash	light grey-brown.	brownish-grey.	light salmon-colored.

These are remarkably good, pure coals, containing very small amounts of ash material, and small proportions of sulphur, more especially the latter two described. They could no doubt be used for the manufacture of coke, although they contain rather more volatile combustible matters than the most profitable coking coals.

No. 2837—COAL. (Sample 3*a*.) *Fifteen miles above Pineville, on Muddy Branch of Clear creek, Bell county. Sample of the upper* 34 *inches of the bed.* Collected by R. C. B. Thruston, July 15th, 1886.

A somewhat weathered sample of splint, or semi-cannel coal.

No. 2838—COAL *from lower part,* 43 *inches in thickness, of the same bed as the next preceding.* Collected by R. C. B. Thruston, July 15th, 1886.

A much soiled and weathered sample of cannel coal.

COMPOSITION OF THESE TWO COALS.—(Air Dried.)

Number in Report.	2837	2838
Hygrometric moisture	1.70	1.00
Volatile combustible matters	32.60	51.60
Coke	65.70	47.40
Totals	100.00	100.00
Total volatile matters	34.30	52.60
Fixed carbon in the coke	62.30	40.40
Ash	3.40	7.00
Totals	100.00	100.00
Percentage of sulphur	0.684	0.739
Character of the coke	spongy.	dense.
Color of the ash	light grey-brown.	brown.

These are both very good coals of their kind, and no doubt, when mined deeper in the bed, would leave less ash than these weathered samples. The cannel coal is very rich in volatile combustible matters. The upper layer would no doubt furnish good coke.

No. 2839—COAL. (Sample 4.) *On James Bussell's land, on Cannon creek, Bell county.* Collected by R. C. B. Thruston, July 20th, 1886. Two seams of coal, 25 and 23 inches thick severally, separated by 17 inches of shale, lie under a shale roof, on a clay floor.

A weathered and soiled sample.

COMPOSITION.—(Air Dried.)

Hygroscopic moisture	0.80	Total volatile matters	34.70
Volatile combustible matters	33.90		
Light spongy coke	65.30	Carbon in the coke	59.90
		Grey-brown ash	5.40
	100.00		100.00
Percentage of sulphur	1.508		

This is a very good splint or semi-cannel coal, verging toward bituminous coal, containing quite a moderate proportion of ash material, and but little more than the average percentage of sulphur.

No. 2840—COAL. (Sample 9.) *Feelan Risner's, on Browney's creek, Bell county.* Sample collected by R. C. B. Thruston, September 22d, 1886.
A weathered sample.

No. 2841—COAL. (Sample 10.) *From the same bed as the next preceding sample, there being only a 1-inch parting of shale between them.*

COMPOSITION OF THESE TWO SAMPLES.—(Air Dried.)

Number in Report.	2840	2841
Hygroscopic moisture	5.40	1.60
Volatile combustible matters	30.00	47.40
Coke	64.60	51.00
Totals	100.00	100.00
Total volatile matters	35.40	49.00
Fixed carbon in the coke	60.50	47.70
Ash	4.10	3.30
Totals	100.00	100.00
Percentage of sulphur	0.436	0.574
Character of the coke	pulverulent.	pulverulent.
Color of the ash	d'k salmon colored.	dark brown.

Both these samples had been somewhat altered by long weathering, the effects of which would be the reduction of the volatile combustible matters and sulphur, with probably an increase of the ash percentage. The removal of the volatile ingredients caused the production of a pulverulent coke. Deeper in the bed, where the coal has not been altered by long weathering, the coke of No. 2840 would no doubt be spongy coherent. No. 2841 has yet the large percentage of volatile combustible matters which characterizes the cannel coals.

No. 2842—Coal. (Sample 5.) *Head of Middle Fork of Williams' Branch of Yellow creek, Bell county.* Collected by R. C. B. Thruston, July 24th, 1886.

This sample is from four several seams, which are, respectively, beginning at the top, 17, 12, 11, and 25 inches thick, divided by shale partings, which are, severally, 7, 2, and 2 inches thick. Another bed of coal, not included in the sample, lies beneath, under a thicker shale parting.

This mixed sample was generally pitch-black coal, of cuboidal structure, breaking with shining, irregular surfaces, containing very little coal of lamellar structure, very little fibrous coal, and no apparent pyrites.

COMPOSITION.—(Air Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	1.60	Total volatile matters	34.80
Volatile combustible matters	33.20		
Light spongy coke	65.20	Carbon in the coke	60.60
		Light grey-brown ash	4.60
	100.00		100.00
Percentage of sulphur	0.876		

This sample has the composition of a good coking coal.

No. 2843—Coal. (Sample 6.) *Land of J. M. Robbins, on Crane creek of Yellow creek, Bell county.* Sample by R. C. B. Thruston, from the upper 36-inch seam of the bed, September 21st, 1886.

A pure-looking, pitch-black coal; structure mostly cuboidal. Fracture irregular, with shining surfaces. Very little fibrous coal, and no pyrites apparent.

No. 2844—Coal. (Sample 7.) *From the lower 23-inch seam* *of the same bed as the next preceding sample, separated from that by a 3-inch shale parting.*

A pure-looking, pitch-black coal: breaking with irregular, shining surfaces. Very little fibrous coal, and no pyrites apparent.

COMPOSITION OF THESE COALS.—(Air Dried.)

Number in Report.	2843	2844
Hygroscopic moisture	1.40	1.20
Volatile combustible matters	32.30	34.90
Coke	66.30	63.90
Totals	100.00	100.00
Total volatile matters	33.70	36.10
Fixed carbon in the coke	63.50	62.10
Ash	2.80	1.80
Totals	100.00	100.00
Percentage of sulphur	0.670	0.529
Character of the coke	dense.	spongy.
Color of the ash	lt. brown-grey.	salmon-colored.

Both these coals are remarkably pure and good, containing only very small proportions of ash material and sulphur. They would doubtless produce very good coke.

No. 2845—COAL. (Sample 8.) *From John M. Marricle's bank, on Cubbog Branch of Browney's creek, Bell county.* Collected by R. C. B. Thruston, September 22d, 1886. Coal, 39 inches: the upper 3 inches of bone coal; lowest 12 inches, soft coal; gas coal, 24 inches, between.

A pretty pure-looking sample, mainly of splint or semi-cannel coal. Portions breaking irregularly, with shining surfaces. But little fibrous coal or pyrites apparent.

No. 2846—COAL. (Sample 11.) *On Richard Risner's land, on Hansee's creek, Bell county.* Collected by R. C. B. Thruston, September 24th, 1886. Sample from the two layers, severally 16 and 53 inches thick, separated by a 1-inch shale parting, the roof being the soil.

A much weathered sample.

No. 2847—Coal. (Sample 14.) *On Andrew Marricle's land, on Cubbog creek, Bell county.* Collected by R. C. B. Thruston, October 6th, 1886. Sample from the two layers, severally 21 and 25 inches thick, separated by a 1-inch parting, with shale roof and clay floor.

A weathered sample.

No. 2848—Coal. (Sample 15.) *On Stone Coal Branch of Browney's creek. Sample from the upper four layers, severally of* 23, 14, 2½, *and* 20 *inches thickness, separated by thin shale partings; shale roof and clay floor. Another* 3*-inch coal and a* 5*-inch shale parting lie below these above the floor.*

A weathered sample.

No. 2849—Coal. (Sample 16.) *Near the head of Browney's creek, Bell county. Forty-four inches, including half an inch of shale* 8 *inches from the top.* Collected by R. C. B. Thruston, October 11th, 1886.

A firm, pure-looking, pitch-black coal. Structure generally cuboidal. Fracture with irregular, shining surfaces. Little or no fibrous coal, and no pyrites apparent.

COMPOSITION OF THESE FIVE BELL COUNTY COALS.—(Air Dried.)

Number in Report.	2845	2846	2847	2848	2849
Hygroscopic moisture . .	0.80	2.20	4.10	2.60	1.40
Volatile combustible mat'rs.	35 30	32.60	29.90	33.20	34.60
Coke	63.90	65.20	66.00	64.20	64.00
Totals	100.00	100.00	100 00	100.00	100.00
Total volatile matters . .	36 10	34.80	34.00	35 80	36.00
Fixed carbon in the coke .	60 20	61.80	61.80	59.60	61.80
Ash	3 70	3.40	4.20	4.60	2 20
Totals	100 00	100.00	100.00	100.00	100 00
Per cent. of sulphur . . .	0.425	0.601	0.739	0.931	0.821
Character of the coke .	spongy.	pulverulent.	dense friable.	dense spongy.	dense spongy.
Color of the ash . . .	light grey-brown.	salmon-colored.	d'k salmon colored.	light brown.	d'k salmon colored.

These are all very good coals. The samples, Nos. 2846, 2847, and 2848, show one of the effects of weathering in their large proportions of moisture. They all would give very good coke, their ash percentage being all below a good average, No. 2849 giving an exceptionally low ash.

BELL COUNTY COALS.—(Continued.)

No. 2850—COAL. *On Four-mile creek of Cumberland river, Bell county. Geological position: Lower Sandy Branch seam. Bed* 37 *inches thick.* Average sample collected by R. C. Ballard Thruston, July 1st, 1887.

A very pure-looking, semi-cannel coal. No pyrites apparent in the sample. Breaking in laminæ, generally with shining, irregular surfaces. Very little fibrous coal apparent.

No. 2851—COAL. (Sample 2.) *One and a half miles up Four-mile creek of Cumberland river, Bell county. Geological position:* 100 *feet above Sand Branch coal.* Collected July 1st, 1887, by R. C. B. Thruston.

Apparently a weathered sample of splint coal. This bed has four seams of coal, 4 to 28 inches thick severally; separated by three shale partings, which are severally from 4 to 17 inches thick.

No. 2852—COAL. (Sample 3.) *Four-mile creek of Cumberland river. Geological position: upper Sandy Branch seam.* Collected by R. C. B. Thruston, July 1st, 1887.

A weathered sample of apparently splint coal.

No. 2853—COAL. (Sample 4.) *Four-mile creek of Cumberland river.* Collected by R. C. B. Thruston, July 1st, 1887. The bed, 745 feet above drainage, has two seams of coal, severally 17 and 21 inches thick, separated by a 1-inch shale parting.

Apparently a weathered sample of what seems to be a splint or semi-cannel coal.

No. 2854—COAL. (Sample 9.) *On Shade Branch of Bennett's Fork of Yellow creek, Bell county. Geological position:*

Hignite seam, 775 feet above drainage. Collected by R. C. B. Thruston, July 15th, 1887.

Coal generally breaking irregularly, with irregular, shining surfaces. Some portions imperfectly laminated. No pyrites apparent, and but very little fibrous coal.

No. 2855—Coal. (Sample 18.) *Head of Steward's Branch, one and a half miles from Pineville, Bell county. Geological position: top of lower coal measures.* Collected by R. C. B. Thruston, November 16th, 1887.

The bed contains four seams of coal, severally from 3 to 20½ inches thick, separated by two half-inch shale partings. This sample is from the upper two seams. The uppermost seam is so badly weathered as to resemble earth rather than coal.

No. 2856—Coal. (Sample 19.) *Head of Steward's Branch, one and a half miles from Pineville, Bell county. Geological position: top of lower coal measures. Sample from the 10½ and 3-inch seams. Same bed as preceding sample.* Collected by R. C. B. Thruston, November 16th, 1887.

COMPOSITION OF THESE BELL COUNTY COALS.

(Air Dried.)

Number in Report.	2850	2851	2852	2853	2854	2855	2856
Hygroscopic moisture . . .	2.00	4.40	4.60	7.60	1.44	6.70	0.80
Volatile combustible matters.	34.60	29.50	28.80	28.94	32.56	30.10	29.76
Coke	63.40	66.10	66.60	63.46	66.00	63.20	69.94
Totals	100.00	100 00	100.00	100.00	100.00	100.00	100.00
Total volatile matters . . .	36.60	33.90	33.40	36.54	34.00	36.80	30.06
Fixed carbon in coke . . .	60.40	60 50	63.60	55.26	53.34	49.80	55.74
Ash	3.00	5 60	3.00	8.20	12.66	13.40	14.20
Totals	100 00	100 00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur . . .	0.507	0 978	0.506	0.603	1.454	1.125	2.965
Character of the coke . . .	dense.	very dense.	pulverulent.	pulverulent.	dense spongy.	pulverulent.	dense.
Color of the ash	light brown.	brown-grey.	light brown.	light brown.	purplish-grey.	brownish-grey.	light purplish-grey.

The so-called cannel coal, No. 2854, owes its dense structure to the large proportion of earthy matters which it contains, giving it a composition approximating that of bituminous shale. Nos. 2855 and 2856 also contain large proportions of ash material, and all three of these coals have quite large proportions of sulphur, more especially No. 2856.

The four other coals, viz: those from Four-mile creek, are remarkably pure, good coals, with ash percentages, severally, of from 3 to 8.20 per cent., and sulphur from 0.506 to 0.978 per cent. These four coals would probably yield good coke, notwithstanding samples Nos. 2852 and 2853 gave a pulverulent coke in our analysis; this fact being very probably owing to the weathered condition of the samples taken. The unweathered coal, from the interior of the bed, would very likely give a good, firm coke.

No. 2857—Coal. *Three-quarters of a mile above the mouth of Kit Island Branch of Straight creek, six miles from Pineville. Bed 3 feet 9 inches thick. Geological position: Sandy Branch coal.* Collected by R. C. B. Thruston, March 13th, 1888.

A jet-black, pure-looking coal, breaking generally irregularly, with irregular, shining surfaces. No pyrites, and but little fibrous coal apparent.

COMPOSITION.—Air Dried.

	Per cent.		Per cent.
Hygroscopic moisture	1.40	Total volatile matters	36.74
Volatile combustible matters	35.34		
Much inflated coke	63.26	Fixed carbon in the coke	60.26
		Very light-brown ash	3.00
	100.00		100.00
Percentage of sulphur	1.222		

A remarkably good semi-cannel coal.

No. 2857*a*—Limonite Iron Ore. (Sample No. 17.) *On the north face of Pine Mountain, three and a half miles east of Pineville, Bell county Oriskany ore. Shows about 6 to 8 inches.* Collected by R. C. B. Thruston, November 15th, 1887.

A dark-brown, irregularly cellular ore, mixed with some lighter brown ochreous ore.

COMPOSITION.—Air Dried.

Iron peroxide	60.517	= 42.862 iron.
Alumina	5.723	
Lime and magnesia carbonates	traces.	
Phosphoric acid	.259	
Siliceous residue	23.940	
Water and loss	9.561	
	100.000	

CLINTON COUNTY.

SOILS.

No. 2858—VIRGIN SOIL. *Hill-side limestone soil. Long's Vineyard, Cartwright's Post-office, Clinton county. Sample taken to the depth of* 10 *inches. Forest growth: walnut, white oak, sugar-tree, and poplar. On St. Louis carboniferous limestone formation.* Collected by R. H. Loughridge.

Soil friable, of a light, dirty, brownish-grey color. All passed through the coarse sieve,* except about 12.5 per cent. of small, irregular fragments of ferruginous sandstone or concretions. Its siliceous residue from digestion in acids all passed through the fine sieve,† except a very small proportion of fine white sand.

No. 2859—VIRGIN SUBSOIL. *Hill-side limestone subsoil. Long's Orchard, Cartwright Post-office, Clinton county. Sample taken at the depth between* 10 *and* 13 *inches.* Collected by R. H. Loughridge.

Slightly lighter-colored than the above surface soil; in pretty firm clods. All passed through the coarse sieve, except about 4 per cent. of irregular, small fragments of ferruginous sandstone or concretions. Its siliceous residue left only a small quantity of fine white sand on the fine sieve.

No. 2860—SOIL. *Mountain sandy soil. Sewell's Mountain,*

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* The coarse sieve has about 64 meshes to the centimeter square.

† The fine sieve has about 1600 meshes to the centimeter square.

of Poplar Mountain range, near Cartwright's Post-office, Clinton county. Forest growth: chestnut, chestnut oak, black gum; some red and white oaks. Sample taken to the depth of 10 *inches.* Collected by R. H. Loughridge. Geological position: on lower coal measures.

Soil of a light buff-grey color; some friable clods. All passed through the coarse sieve, except one or two small fragments of ferruginous sandstone or concretions. Its siliceous residue all passed through the fine sieve, except about 8.3 per cent. of fine white sand.

No. 2861—VIRGIN SOIL, *from one mile west of Cartwright's Post-office. Taken to the depth of* 12 *inches. Forest growth: chestnut and red oak. Said to be the poorest soil in Clinton county, excepting that of Poplar Mountain summit.* Collected by R. H. Loughridge.

Soil of a light, dirty, buff-grey color; contains some friable clods. All passed through the coarse sieve, except about 4 per cent. of small fragments of ferruginous sandstone or concretions. Its siliceous residue left about 4.5 per cent. of fine white sand on the fine sieve.

No. 2862—RED UNDER-CLAY, *of the chestnut soil, from one mile west of Cartwright's Post-office, Clinton county. Sample taken from* 18 *to* 24 *inches below the surface.* Collected by R. H. Loughridge.

Subsoil of a dull, orange-red color, in friable clods. When powdered, it is of a handsome orange tint. The coarse sieve removed from it about 8.9 per cent. of irregular small fragments of ferruginous sandstone. Its siliceous residue all passed through the fine sieve, except about 2.5 per cent. of fine white sand.

COMPOSITION OF THESE CLINTON COUNTY SOILS.

(Calculated Dried at 212° F.)

Numbers in Report.	2858	2859	2860	2861	2862
Organic and volatile mat'rs	3.511	2.998	2.985	2.618	5.483
Alumina	6.757	6.215	4.243	4.361	7.335
Iron and manganese ox'es					13.188
Lime carbonate	.405	.305	.151	.051	trace.
Magnesia	.078	.055	.145	.109	.240
Phosphoric acid (P_2O_5) .	.146	.065	.097	.064	.267
Potash extracted by acids .	.340	.537	.851	.247	.231
Soda extracted by acids .	.518	.247	.317	.256	.077
Water expelled at 400° F .	.846	.860	.514	.453	1.285
Sand and insoluble silicates.	87.366	88.706	90.784	91.928	71.047
Totals	99.962	99.988	99.587	100.087	99.153
Moisture expelled at 212° F.	1.368	1.625	0.705	0.700	2.625
Potash in siliceous residue .	.394	.497	.417	.422	.171
Soda in siliceous residue .	not est.	.214	not est.	not est.	not est.
Fine white sand	small.	small.	8.300	4.532	2.567
Gravel and rock fragments.	12.500	4.269	2.361	4.080	9.940
Character of the soil . . .	virgin.	v. subsoil.	sandy.	virgin.	under-clay.

With the exception of Nos. 2858 and 2862, phosphoric acid is deficient in these soils, more especially in Nos. 2859 and 2861. Carbonate of lime is quite deficient in Nos. 2861 and 2862. Organic and volatile matters are very small in proportion in all, especially in Nos. 2859, 2860, and 2861, and are only in small proportions in Nos. 2858 and 2862. In the latter soil, very probably, combined water of the iron oxide, driven off at red heat, increases the small sum. Alumina and iron oxide are in very large proportions in 2862, more especially the iron oxide, which gives to the soil its orange-red color. In 2860 and 2861 these ingredients are quite deficient. Potash was found in larger proportions in all than their general character and large proportions of sand and insoluble silicates seemed to warrant. These insoluble materials, it is seen, are quite large in all but No. 2862, more especially in Nos. 2860 and 2861. Such sandy soils can only be made permanently productive by a judicious use of appropriate fertilizers.

HARLAN COUNTY.

COALS.

No. 2863—COAL. *Head of Luna's creek, about* 1400 *feet above the river at Big Stone Gap, Harlan county. Upper part of the bed* 59 *inches thick; lower part* 15 *inches; separated by a* 1½-*inch parting.* Collected by A. R. Crandall, June 25th, 1887.

A pure-looking, pitch-black coal; generally irregularly laminated, with some little fibrous coal between the laminæ. Portions breaking irregularly, with shining, irregular surfaces. No pyrites apparent in the sample.

No. 2864—CANNEL COAL. (Sample 6.) *Eight miles from Mount Pleasant, at the head of Catteran's creek of Martin's Fork, Harlan county.* Collected by R. C. B. Thruston, July, 1887. Sample from a 22-inch seam, in bed containing three seams, two of stone-coal, severally 18 and 6 inches thick, separated by a 2-inch shale parting; 120 feet above drainage.

A dull, grey-black cannel coal; irregularly laminated. No fibrous coal or pyrites apparent in sample.

No. 2865—COAL. (Sample No. 7.) *At head of Catteran's creek of Martin's Fork,* 155 *feet above drainage; eight miles above Mount Pleasant, Harlan county.* Collected by R. C. B. Thruston, July, 1887.

A bright, pitch-black coal; fracture irregularly cuboidal and irregular, with shining surfaces. No pyrites or fibrous coal apparent.

No. 2866—COAL. (Sample No. 8.) *On John Bell Branch, head of Catteran's creek of Martin's Fork, nine miles from Mount Pleasant, Harlan county;* 365 *feet above drainage.* Collected by R. C. B. Thruston, July, 1887, from two lower seams in a bed containing five several seams of coal, separated by shale partings.

Apparently a splint coal, somewhat weathered. Some little granular pyrites apparent in the sample.

No. 2867—COAL. (Sample 11.) *From near the head of Catteran's creek of Martin's Fork of Cumberland river, Harlan* *county.* Collected by R. C. B. Thruston, August 2d, 1887. Sample from three upper seams of a bed containing several seams, some of which are separated by shale partings.

A very badly weathered sample.

No. 2868—COAL. (Cannel?) (Sample 12.) *From the lower two seams of the same coal bed from which the next preceding sample was taken. Seams severally* 12 *and* 16 *inches thick, separated by a* 9-*inch shale parting.* Collected by R. C. B. Thruston, August 8th, 1887.

Resembles a cannel coal.

No. 2869—COAL. (Sample 13.) *On Trace Branch of Clover creek of Cumberland river, Harlan county.* Collected by R. C. B. Thruston, September 2d, 1887.

Sample mostly in a much crumbled condition.

No. 2870—COAL. (Sample 14.) *On Slick Rock Branch of Clover Fork of Cumberland river.* Collected by R. C. B. Thruston, September 3d, 1887. Sample from the three lower seams of a bed containing four or five seams, separated by thin shale partings.

Sample much crumbled and somewhat weathered.

No. 2871—COAL. (Sample 21.) *From near the mouth of Terry's Branch of Wallen's creek, Harlan county. Geological position: near the base of the lower coal measures.* Collected by R. C. B. Thruston, November 17th, 1887. Received at laboratory January 26th, 1888.

A pure-looking, jet-black coal, breaking generally irregularly, with irregular, shining surfaces. No pyrites or fibrous coal apparent in the sample. Sample taken from the lowest seam, 23 inches thick, from a bed containing three different seams of coal.

No. 2872—COAL. (Cannel?) (Sample 20.) *From two upper seams of the same coal bed as the next preceding. Seams severally* 8 *and* 13 *inches thick.*

A dull-black coal, breaking imperfectly in laminæ. Fracture sometimes very flat conchoidal. No pyrites or fibrous coal apparent in the sample.

COMPOSITION OF THESE HARLAN COUNTY COALS.

(Air Dried.)

Number in Report.	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872
Hygroscopic moisture	3.00	1.66	1.86	1.74	2.50	0.80	1.40	3.60	0.90	0.90
Volatile combustible matters	31.40	42.80	30.74	33.32	31.90	37.30	32.00	29.40	34.30	30.10
Coke	65.60	55.54	67.40	64.94	65.60	61.90	66.60	67.00	64.80	69.00
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	34.40	44.46	32.60	35.06	34.40	38.10	33.40	33.00	35.20	31.00
Carbon in the coke	56.30	35.44	65.00	59.24	61.80	54.90	62.30	57.00	62.50	42.40
Ash	9.30	20.10	2.40	5.70	3.80	7.00	4.30	10.00	2.30	26.60
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	0.604	0.549	0.493	1.034	0.438	1.925	0.712	0.622	0.577	1.084
Character of the coke	dense.	pulverulent.	spongy.	spongy.	dense.	dense spongy.	dense spongy.	pulverulent.	inflated.	dense friable.
Color of the ash	lt. buff-grey.	lt. grey-brown.	light brown.	light brown.	light brown.	purplish brown.	light brown.	light grey.	lt. grey-brown.	lt. pur'h grey.

The cannel coals. Nos. 2864 and 2872, are diminished in value by their 20.10 and 26.60 percentages of ash; otherwise they may be usefully employed as fuel. No. 2868 resembles a cannel coal, but gave only 37.30 per cent. of volatile combustible matters, and left a dense coke. Its ash is only 7.00 per cent., which is small for cannel coals, but its sulphur is nearly 2 per cent.

Nos. 2865, 2867, 2869, 2866, and 2871 are very good coals, their ash percentages being severally only 2.40, 3.80, 4.30, 5.70, and 2.30.

The ash percentages of Nos. 2863, 2864, 2870, and 2872, are much larger, being severally 9.30, 20.10, 10.00, and 26.60 per cent.

The weathered samples of coals always show to a disadvantage in their analyses, owing to loss of their volatile combustible matters and the admixture of earthy materials.

HARLAN COUNTY COALS.—(Continued.)

No. 2873—COAL. (Sample 17.) *Head of Puckett's creek, Harlan county. Sample from two upper seams,* 41 *and* 5 *inches severally, separated by a* 2-*inch shale parting; in a bed which contains nine seams of coal, separated by partings of shale, varying from half an inch to* 18 *inches in thickness.* Collected by R. C. B. Thruston, October, 1886. (This coal is 80 feet above coal sample 18, near the top of the 10 feet 10 inch bed.)

Apparently a good splint coal, showing but little fibrous coal, and no apparent pyrites.

No. 2874—COAL. (Sample 18.) *Head of Puckett's creek, Harlan county. Sample* 80 *feet below sample* 17. *Coal* 44 *inches thick. Clay beneath.* Collected by R. C. B. Thruston, October 12th, 1886.

Mostly splint coal, with some softer coal of irregular fracture. No apparent pyrites, and but little fibrous coal.

No. 2875—COAL. (Sample 19.) *Near head of Puckett's creek, Harlan county. Coal* 54 *inches thick;* 665 *feet* *below that of sample* 18. Collected by R. C. B. Thruston, October 12th, 1886.

A pure-looking coal; mostly splint, with some softer coal of irregular fracture, with shining surfaces.

COMPOSITION OF THESE PUCKETT CREEK COALS.—(Air Dried.

Number in Report.	2873	2874	2875
Hygroscopic moisture	4.00	2.40	1.80
Volatile combustible matters	31.00	34.20	34.20
Coke	65.00	63.40	64.00
Totals	100.00	100.00	100.00
Total volatile matters	35.00	36.60	36.00
Fixed carbon in the coke	56.00	60.60	60.10
Ash	9.00	2.80	3.90
Totals	100.00	100.00	100.00
Percentage of sulphur	1.027	0.684	0.917
Character of the coke	friable.	dense spongy.	dense spongy.
Color of the ash	grey-brown.	grey-brown.	brownish-grey.

The coals Nos. 2874 and 2875, very much alike in composition, are remarkably good splint or semi-cannel coals, which would produce coke of the best quality. No. 2873 contains more ash material than these, but its large proportion of moisture indicates that the sample was from the weathered outcrop of the bed, and it is probable that the coal deeper in the bank, where it has not undergone partial decomposition under the atmospheric agencies, will be found to be much more pure.

No. 2876—COAL. (Sample 20.) *Land of James Howard, on Martin's Fork of Cumberland river, at base of the Cumberland mountains, Harlan county. Sixty-eight inches of solid coal.* Sample collected by R. C. B. Thruston, October 14th, 1886.

A somewhat weathered sample of splint coal.

No. 2877—COAL. (Sample 21.) *James Howard's, on Black mountain, Martin's Fork, Harlan county;* 250 *feet above* *drainage.* Sample collected by R. C. B. Thruston, October 14th, 1886.

A pretty pure-looking sample of splint coal. Some portions of irregular fracture, with shining surfaces. Very little fibrous coal, and no pyrites apparent.

No. 2878—COAL. (Sample 22.) *On Broad Branch of Martin's Fork, Harlan county. Coal 43 inches thick.* Sample collected by R. C. B. Thruston, October 14th, 1886.

A pure-looking, pitch-black coal, breaking readily with irregular shining surfaces. No fibrous coal or pyrites apparent.

No. 2879—COAL. (Sample 25.) *On Crumbie's Branch of Martin's Fork of Cumberland river, Harlan county.* Sample collected by R. C. B. Thruston, October 16th, 1886. Two seams of coal, 36 and 5 inches thick severally, separated by an 11-inch slate parting.

A pure-looking, firm, pitch-black splint or semi-cannel coal. But little fibrous coal, and no pyrites apparent.

COMPOSITION OF THESE MARTIN'S FORK COALS.—(Air Dried.)

Number in Report.	2876	2877	2878	2879
Hygroscopic moisture	2.00	1.10	1.20	1.20
Volatile combustible matters	33.40	32.90	33.00	35.10
Coke	64.60	66.00	65.80	63.70
Totals	100.00	100.00	100.00	100.00
Total volatile matters	35.40	34.00	34.20	36.30
Fixed carbon in the coke	61.60	63.40	61.80	57.10
Ash	3.00	2.60	4.00	6.60
Totals	100.00	100.00	100.00	100.00
Percentage of sulphur	0.643	0.519	0.628	1.906
Character of the coke	very dense.	very dense.	dense spongy	dense.
Color of the ash	light salmon-colored.	dark salmon-colored.	grey-brown.	grey-purple.

Nos. 2876, 2877, and 2878 are remarkably good coals, and could be profitably used in the manufacture of the best quality of coke. No. 2879 contains rather more ash and sulphur, and less fixed carbon, yet is also a very good coal of the semi-cannel variety.

HARLAN COUNTY COALS.—(Continued.)

No. 2880—COAL. (Sample 23.) *On land of G. W. Smith, on Crank's creek, Harlan county. Coal* 43 *inches thick, with sandstone roof, and floor of clay* 2 *inches thick, resting on sandstone.* Collected by R. C. B. Thruston, October 15th, 1886.

A somewhat weathered sample.

No. 2881—COAL. (Sample 24.) *On Crank's creek, Harlan county. Forty-two inches of solid coal,* 400 *feet above that of sample* 23. Collected by R. C. B. Thruston, October 15th, 1886.

A bright, pitch-black coal, breaking generally with irregular shining surfaces. But little fibrous coal, and no pyrites apparent.

COMPOSITION OF THESE CRANK'S CREEK COALS.—(Air Dried.)

Number in Report.	2880	2881
Hygroscopic moisture	3.20	2.80
Volatile combustible matters	33.60	32 00
Coke	63.20	65.20
Totals	100.00	100.00
Total volatile matters	36.80	34.80
Fixed carbon in the coke	56.80	62 80
Ash	6.40	2.40
Totals	100.00	100.00
Percentage of sulphur	1.782	0.354
Character of the coke	very dense.	dense.
Color of the ash	light brown.	light brown.

No. 2881 is a remarkably good, pure coal, which would yield very good coke. No. 2880, a weathered sample, probably does not fairly represent the character of the unweathered coal deeper in the bed; yet it is better than the general average of coals in quality, leaving only 6.40 per cent. of ash. Its considerable proportion of sulphur might be objectionable when it is applied to some purposes.

HARLAN COUNTY COALS.—(Continued.)

No. 2882—COAL. (Sample A.) *Head of Luna's creek of Poor Fork of Cumberland river, Harlan county. Geological position: upper coal measures. Total thickness of seam,* 6 *feet* 6 *inches, but only* 5 *feet sampled.* Collected by R. C. B. Thruston, December 12th, 1887.

Sample somewhat weathered, and partly in a powdered condition. Some portions dull-black.

No. 2883—COAL. (Sample B.) *Head of Camp Fork of Luna's creek, Harlan county. Upper coal measures.* Collected by R. C. B. Thruston, December 13th, 1887.

Sample somewhat weathered; partly pulverized.

No. 2884—COAL. (Sample C.) *Head of Rockhouse Branch of Luna's creek, Harlan county. Upper coal measures.* Collected by R. C. B. Thruston, December 18th, 1887.

A pure-looking coal, generally. Some portions imperfectly laminated, with some little granular pyrites and fibrous coal apparent; other portions breaking irregularly, with shining, irregular surfaces.

No. 2885—COAL. (Sample D.) *Near the mouth of Luna's creek of Poor Fork of Cumberland river, Harlan county.* Collected by R. C. B. Thruston, December 14th, 1887.

A pure-looking coal, mostly imperfectly laminated. Some surfaces brilliant and irregular; others dull, showing a little fine granular pyrites.

No. 2886—COAL. (Sample E.) *Elkhorn bed, near the mouth of Luna's creek, Harlan county. Thirty feet above the last sample, and* 270 *feet above the bed of the creek.* Collected by R. C. B. Thruston, December 14th, 1887.

A pure-looking coal, breaking generally irregularly, with shining surfaces. Very little fibrous coal or pyrites apparent.

No. 2887—COAL. *Near the mouth of Luna's creek of Poor Fork of Cumberland river, Harlan county. Geological position:* 25 *feet above sample E. Bed* 48 *inches thick.* Collected by R. C. B. Thruston, December 14th, 1887.

A much weathered sample.

No. 2888—**Coal.** (Sample G.) *Cold Iron Branch of Poor Fork of Cumberland river, Harlan county. Lower coal measures. Bed 42½ inches.* Collected by R. C. B. Thruston, December 18th, 1887.

A good-looking coal. Mosly lamellar in structure. Portions breaking irregularly, with irregular, shining surfaces. Some little granular pyrites and fibrous coal apparent in the sample.

No. 2889—**Coal.** (Sample H.) *Cold Iron Branch of Poor Fork of Cumberland river, Harlan county. Elkhorn bed of lower coal measures, 25 feet above sample G. Bed 55½ inches thick.* Collected by R. C. B. Thruston, December 15th, 1887.

Generally a fine-looking coal. Breaking with irregular, shining surfaces. Some portions laminated, and more dull in appearance, with some little fine granular pyrites apparent.

No. 2890—**Coal.** *On Turkey-pen Branch, 15 miles, on Poor Fork, above Harlan Court-house, Harlan county. Lower coal measures.'* Collected by R. C. B. Thruston, December 22d, 1887.

COMPOSITION OF THESE HARLAN COUNTY COALS.

(Air Dried.)

Number in the Report.	2882	2883	2884	2885	2886	2887	2888	2889	2890
Hygroscopic moisture	1.90	3.20	2.10	2.20	5.70	9.60	1.80	2.40	2.30
Volatile combustible matters	28.90	28.06	32.90	33.80	32.90	30.20	31.60	31.70	31.50
Coke	69.20	68.74	65.00	64.00	61.40	60.20	66.60	65.90	66.20
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	30.80	31.26	35.00	36.00	38.60	39.80	33.40	34.10	33.80
Carbon in the coke	61.10	60.44	56.60	61 00	58 80	50.12	63.20	63.70	61.60
Ash	8.10	8 30	8.40	3.00	2.60	10.08	3.40	2.20	4.60
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	0.486	0.541	0.774	0.552	0.425	0.560	1 181	0.312	0.560
Character of the coke	spongy.	dense friable.	dense.	dense spongy.	light spongy.	pulverulent.	light spongy.	dense spongy.	spongy.
Color of the ash	light grey-brown.	light brown.	lt. brown'h grey.	very light brown.	very light brown.	nearly white.	light brown.	light brown.	lt. brown'h grey.

These are, generally, very good coking coals, yielding from 60.20 per cent. in No. 2887, up to 69.20 per cent. in No. 2882. Their proportions of ash range from 2.20 per cent. in No. 2889 up to 10.08 in No. 2887, and 8.10, 8.30, and 8.40, severally, in Nos. 2882, 2883, and 2884. But 2887 was a much weathered sample, and the other three had also been somewhat altered by exposure, and may not, therefore, fairly represent the character of the interior of the beds. The sulphur is quite small, except in Nos. 2888 and 2884.

No. 2891—IRON ORE. (*Limonite.*) *From 27 miles above Harlan Court-house, on Poor Fork of Cumberland river, Harlan county. Position: near base of lower coal measures.* Collected by R. C. B. Thruston, December 2d, 1887.

COMPOSITION.—(Air Dried.)

Iron peroxide	44.200	= 39.940 iron.
Alumina	9.080	
Lime carbonate	20.000	
Magnesia carbonate	4.238	
Phosphoric acid (P_2O_5)	2.726	= 1.173 phosphorus.
Sulphur	a trace.	
Silica	12.600	
Water and loss	7.156	
	100.000	

KNOX COUNTY.

No. 2892—COAL. *Two and a half feet thick; on Golden Fork of Poplar creek, Knox county.* Collected by A. R. Crandall.

COMPOSITION.—(Air Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	0.40	Total volatile matters	37.60
Volatile combustible matters	37.20		
Light spongy coke	62.40	Fixed carbon in the coke	56.46
		Light grey ash	5.94
	100.00		100.00
Percentage of sulphur	0.820		

A good, pure coal.

LAUREL COUNTY.

No. 2893—COAL. *S. E. Owsley's, Laurel county.* Sample brought by A. R. Crandall, August, 1886.

COMPOSITION.—(Air Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	3.40	Total volatile matters	37.20
Volatile combustible matters	33.80		
Dense spongy coke	62.80	Fixed carbon in the coke	58 80
		Nearly white ash	4.00
	100.00		100.00
Percentage of sulphur	0.930		

A very good coal, which would doubtless make good coke.

No. 2894—COAL *from near Lily, Laurel county. Bed 46 inches thick.* Sample collected December 25th, 1887, by Dr. L. H. Blanton.

A bright, pure-looking coal, breaking generally irregularly, with irregular, shining surfaces. No pyrites or fibrous coal apparent in the sample.

COMPOSITION.—(Air Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	2.70	Total volatile matters	37.30
Volatile combustible matters	34 60		
Spongy coke	62.70	Fixed carbon in the coke	59 70
		Light grey ash	3.00
	100.00		100.00
Percentage of sulphur	1.923		

A good semi-cannel coal, giving but a small proportion of ash. Its somewhat large proportion of sulphur might be a drawback in the use of its coke in the iron manufacture.

LIVINGSTON COUNTY.

No. 2895—HYDRAULIC LIMESTONE *from Smithland, Livingston county.* Sent from Frankfort for analysis, January 9th, 1888.

A compact, very dark-grey limestone.

COMPOSITION.—(Air Dried.)

	Per cent.	
Lime	46.788	
Magnesia	.782	
Alumina and iron oxide	12.170	with a trace of phosphoric acid.
Potash	.057	
Soda	.039	
Silica	9.000	including 0.8 of soluble silica.
Carbonic acid and moisture	31.164	
	100.000	

This has the composition of some hydraulic limestones; but it does not contain as much silica, alumina, and iron oxide as the harder-setting cements, and may not be as durable as these. It will require much care in its calcination, because when too much burnt it loses its property of hardening under water. In an experiment made by the writer, the powdered stone having been submitted to a red heat for two hours, then mixed with water to a paste, and, after standing for a quarter of an hour, put under water, hardened after a day or so; but another portion, which had been heated for a longer time, did not harden much under water in twenty-four hours.

MARION COUNTY.

MINERAL WATERS.

No. 2896—MINERAL WATER, *from the well of Mr. Charles H. Burns, in the town of Lebanon, Marion county. The same water was struck about 45 feet from the base of the black slate, in the mud sandstone, just above the Hudson group; also, in the gas well now being bored near the Burns well. The water is in large quantity. In the gas well the water tastes strongly of sulphur.*

Sample, collected by Mr. W. T. Knott, was sent in quart bottles, well corked and sealed. It had no smell of sulphur when received, June 19th, 1887.

No. 2897—WATER, *from Harrison's spring, about 2 miles east of Lebanon, Marion county; in the ash-colored shales lying just above the black slate.* Sample collected by W. T. Knott, June 17th, 1887.

No. 2898—**Water**, *from Johnston's well, about 2 miles east of Lebanon. This water comes from the black slate formation near its base.* Sample sent by Mr. W. T. Knott, June 17th, 1887.

COMPOSITION OF THESE MARION COUNTY MINERAL WATERS.

(In 1000. parts of the waters.)

Numbers.	2896	2897	2898	
Carbonic acid gas . . . Hydrogen sulphide gas .	small quants. not est.	none.	small quantities; not estimated.	
Lime carbonate	0.107	0.650	small quantity; not estimated.	Held in solution by the carbonic acid.
Magnesia carbonate . .	.020	.170	small quantity; not estimated.	
Iron carbonate	.028	. . . . . .	. . . .	
Sodium chloride	12.767	.132	small quantity; not est.	
Calcium chloride	1.062	. . . . . .	. . . .	
Magnesium chloride. . . .	.857	. . . . . .	. . . .	
Potassium chloride	. . . . . .	.201	. . . .	
Calcium sulphate	. . . . . .	1.109	small quantity; not est.	
Magnesium sulphate . . .	.280	4.014	small quantity; not est.	
Potassium sulphate	.187	. . . . . .	. . . .	
Sodium sulphate	. . . . . .	1.658	. . . .	
Sodium sulphide	. . . . . .	. . . . . .	small quantity; not est.	
Lithia and bromine . . .	traces.	. . . . . .	. . . .	
Organic matter	trace.	. . . . . .	. . . .	
Silica	.010	not est.	not estimated.	
Total saline matters, in 1000. parts	15.263	7.984	1.760	

The water of No. 2896 is a good saline chalybeate, with but a small proportion of hydrogen sulphide; that of 2897, containing only about half as much total saline matters, has a larger proportion of magnesium sulphate (Epsom salt), and also of calcium and sodium sulphates. It (No. 2897) is a good weak saline water. No. 2898 is a very weak saline water, containing a little sodium sulphide and hydrogen sulphide, which may give it a weak sulphurous taste when fresh from the well.

MUHLENBERG COUNTY.

COKE.

No. 2899—**Coke**, *made of coal from three-quarters of a mile northwest of Mud River Coal Mines, Mud River, Muhlen-*

berg county, Kentucky. Land of William Willis, Jr. Bed 44 inches thick. Samples sent from Frankfort, October 8th, 1887.

There were two samples in the box, made from the upper and lower part of the bed, of pure-looking coke. Average portions of the two were mixed and analyzed.

COMPOSITION.—(Air Dried.)

Moisture and volatile matters expelled at red heat	0.20
Carbon in the coke	90.20
Purplish-grey ash	9.60
	100.00
Percentage of sulphur	1.26

A good average coke.

No. 2900—Cannel Coal. *On land of G. F. McNary, near the western border of Muhlenberg county. Bed 22 inches thick, overlying coal No.* 11. Sample collected by Charles Eaves, Greenville, Muhlenberg county.

Coal generally dull black; imperfectly laminated. Some portions breaking with imperfect, broad conchoidal fracture. Some surfaces shining, and one part iridescent. No fibrous coal, and only a few bright scales of pyrites apparent.

COMPOSITION.—(Air Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	2.66	Total volatile matters	39.40
Volatile combustible matters	36.74		
Spongy coke	60.60	Carbon in the coke	42.20
		Dark purplish-brown ash	18.40
	100.00		100.00
Percentage of sulphur	7.526		

This coal contains too much sulphur and ash materials to be profitable in competition with better neighboring samples.

PIKE COUNTY.

IRON ORE.

No. 2901—Limonite Iron Ore. Collected by C. M. Parsons, Pike county, Kentucky. Sent from Frankfort January 3d, 1888.

A pretty dense ore, dark brown in the denser portions; brownish-yellow in the more friable parts.

COMPOSITION.—(Air Dried.)

	Per cent.	
Iron peroxide	66.37	= 46.46 iron.
Alumina	12.27	
Phosphoric acid (P_2O_5)	3.04	= 1.319 phosphorus.
Lime carbonate	.20	
Magnesia	a trace.	
Siliceous residue	2.60	
Sulphur	a trace.	
Water and loss	15.52	
	100.00	

A rich iron ore, containing but little sulphur, and more than average phosphorus.

SIMPSON COUNTY.

No. 2902—SULPHUR WATER. *Sample sent by the Board of Council of the town of Franklin, for quantitative analysis.* Sample in two half-gallon bottles; received June 16th, 1887. (Analysis paid for by the Board of Council.)

COMPOSITION.—(In 1000. parts of the water.)

Carbonic acid gas Hydrogen sulphide gas	amount not estimated.	
Calcium carbonate	0.1518	Held in solution in the water by carbonic acid.
Magnesium carbonate	.0044	
Iron carbonate	.0169	
Sodium chloride	.1700	
*Sodium sulphide	.0930	
Iron sulphide	.0044	In the sediment in the bottles.
Potassium sulphate	.0184	
Calcium sulphate	.7410	
Magnesium sulphate	1.3050	
Silica	.0078	
Boracic acid	a trace; not estimated.	
Organic matters	a trace; not estimated.	
Total saline matters in 1000 parts of the water	2.5127	

A good saline sulphur water, resembling Blue Lick water, but containing much less sodium chloride (common salt) than that. It also has much more magnesium sulphate (Epsom salt) than that celebrated mineral water, making it more aperient in its action.

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* Probably more of this salt would be found in the water analyzed fresh from the well.

WHITLEY COUNTY.

COALS.

No. 2903—COAL. *Upper two feet of Bennett's coal.* (*Overlying 7 inches of fire-clay.*) *On Harp's creek, Whitley county.* Sample collected by A. R. Crandall.

No. 2904—COAL. *Lower* 3 *feet of Bennett's coal, &c.* Collected by A. R. Crandall.

COMPOSITION.—(Air Dried.)

Number in Report.	2903	2904
Hygroscopic moisture	2.46	1.60
Volatile combustible matters	34 14	34.00
Coke	63.40	64.40
Totals	100.00	100.00
Total volatile matters	36.60	35.60
Fixed carbon in the coke	57.80	56.80
Ash	5.60	7.60
Totals	100.00	100.00
Percentage of sulphur	0.848	0 820
Character of the coke	spongy.	spongy.
Color of the ash	brownish-grey.	light grey.

They are both good coals, of the splint variety. The upper bed gives rather the purer sample.

WHITLEY COUNTY COALS.—(Continued.)

No. 2907—COAL, *from the Procter Company's coal mine, Indian creek, Whitley county. Entry No.* 7, *Room No.* 12. *Average sample from the whole face of the bed. Upper bench* 21 *inches thick; lower bench,* 22 *inches.* Collected by A. R. Crandall, March 12th, 1888.

A pure-looking, jet-black coal; breaking generally irregularly, with irregular, shining surfaces. Imperfectly laminated. Very little fibrous coal, and no pyrites apparent in the sample.

No. 2908—Coal, *from same mine. Entry No. 5, Room No. 10. Average of the lower 22-inch seam.* Collected by A. R. Crandall, same date as the above sample.

Resembles the preceding.

No. 2909—Coal, *from same mine. Entry No. 5. Average sample of the upper bench.* Collected as above stated.

Resembles the preceding samples.

COMPOSITION OF THESE COALS.—(Air Dried.)

Number in Report.	2907	2908	2909
Hygroscopic moisture	2.00	2.60	1.80
Volatile combustible matters	33.70	33.20	35.00
Coke	64.30	64.20	63.20
Totals	100.00	100.00	100.00
Total volatile matters	35.70	35.80	36.80
Fixed carbon in the coke	61.90	62.20	60.60
Ash	2.40	2.00	2.60
Totals	100.00	100.00	100.00
Percentage of sulphur	0.796	0.769	0.714
Character of the coke	light spongy.	light spongy.	light spongy.
Color of the ash	very light brownish-grey.	light grey-brown.	very light brownish-grey.

These are remarkably good semi-cannel coals, containing remarkably small proportions of ash, and not an inordinate percentage of sulphur. They would yield very good coke if proper means were used in the coking to prevent it from being too light and spongy.

Tennessee Coals.

No. 2905—Coal. (Sample 10.) *Head of Little Coal Branch of Tackett's creek of Clear Fork of Cumberland river, Claiborne county, Tennessee.* Collected by R. C. B. Thruston, July 15th, 1887. Geological position: Dean's coal. Sample from lower seam, 40 inches thick, of the bed, which contains three seams of coal.

A pure-looking coal, breaking generally with shining, irregular surfaces. Imperfectly laminated. No pyrites or fibrous coal apparent in the sample.

No. 2906—Coal. (Sample 11.) *Mouth of Big Sugar Branch of Bennett's Fork of Yellow creek, Claiborne county, Tennessee. Sample from a 19-inch middle seam, in a bed containing two other seams of coal, 34 and 7 inches thick, severally.* Collected by R. C. B. Thruston, July 15th, 1887.

COMPOSITION OF THESE TENNESSEE COALS.—(Air Dried.)

Number in Report.	2905	2906
Hygroscopic moisture	2.10	7.00
Volatile combustible matters	34.24	30.90
Coke	63.66	62.10
Totals	100.00	100.00
Total volatile matters	36.34	37.90
Fixed carbon in the coke	55.26	58.30
Ash	8.40	3.80
Totals	100.00	100.00
Percentage of sulphur	1.427	0.685
Character of the coke	dense.	pulverulent.
Color of the ash	light purplish-grey.	lt. brownish-grey.

No. 2906 appears to be a weathered sample.

TABLE I.—COALS.—(Air Dried.)

Number	County.	Hygroscopic moisture	Volatile combustible matters	Coke.	Total volatile matters	Fixed carbon in the coke	Ash.	Sulphur	Character of the coke.	Color of the Ash.	Specific gravity	Remarks.
2578	Bell	0.86	41.54	57.60	42.40	50.60	7.00	5.078	Light spongy	Grey-brown	....	Browning's cannel coal, Cumb'land river.
2579	Bell	1.00	34.90	64.10	35.90	55 70	8.40	1.329	Light spongy	Purplish-grey	....	Myers' coal, Lower Br. of Yellow creek.
2580	Bell	.88	37.72	61.40	38.60	57.40	4.00	1.783	Light spongy	Light grey-brown	....	On Caney Branch of Yellow creek.
2581	Bell	.80	33.94	65.26	34.74	58.86	6.40	1.398	Light spongy	Light purplish-grey	....	Jas. Barnett's, Clear Fork Yellow creek.
2582	Bell	1.20	37.90	60.90	39.10	57.78	3.12	1.030	Light spongy	Dark grey	....	F. R. Barner's, Yellow creek.
2583	Bell	1.16	36.84	62.00	38.00	57.50	4.50	1.535	Spongy	Light grey	....	Myer's coal, Yellow creek.
2584	Bell	1.40	38.60	60.00	40.00	57.30	2.70	.629	Light spongy	Light brown	....	Alf. McTee's coal, Yellow creek.
2585	Bell	2.00	35.20	62.80	37.20	58.80	4.00	.637	Dense spongy.	Light brown	....	Dean seam, lower 36 inches, Greasy cr.
2586	Bell	1.50	32.90	65.60	34.40	60.00	5.60	.692	Light spongy	Whitish	....	Dean seam, average sample.
2587	Bell	.92	36.08	63.00	37.00	58.00	5.00	1.343	Spongy	Light grey-brown	....	W. D. King's coal, Yellow creek.
2588	Bell	2.20	33.94	63.86	36.14	62.06	1.80	.491	Light spongy	Light brownish-grey	....	Dorton coal bank, near Pineville.
2610	Breathitt	2.80	36.60	63.60	36.40	54 20	9.40	.695	Dense	Brownish-grey	....	Wolf creek.
2611	Breathitt	2.00	35.36	62.64	37.36	57.36	5.28	1.019	Light spongy	White	....	Berry Turner's, Long's creek
2612	Breathitt	7.40	30.20	62.40	37.60	52.04	10.36	.621	Pulverulent	Very light salmon	....	Gouch & Co., John Little's, Br. Ky. river.
2613	Breathitt	3.80	34.40	61.80	38.20	51.80	10.00	.585	Dense	Grey-brown	....	Green Taulbee's.
2614	Breathitt	9.60	29.46	60.94	39.06	44.18	16.80	.478	Pulverulent	Light brownish-grey	....	L. H. Noble's, Leatherwood Br. Lost cr.
2615	Breathitt	2.80	31.16	66.04	33.96	53.34	12.70	.690	Dense	Light brownish-grey	....	Head of Leatherwood Branch.
2616	Breathitt	3.80	32.30	63 90	36.10	48.80	15.10	.840	Pulverulent	Light reddish	....	Head Leatherwood Br.; bituminous coal.
2617	Breathitt	.80	41.70	57.50	42.50	33.30	24.20	.952	Pulverulent	Light pink	....	Head of Leatherwood Br.; cannel coal.
2618	Breathitt	1.20	53.80	45.00	55.00	39.46	5.54	.722	Dense	Light brick-colored	....	Goff & Co., John Little Br.; cannel coal.
2619	Breathitt	1.00	41.10	57.90	42.10	46.70	11.20	1.120	Dense	Dark grey	....	Crawford's; Mid'le Br. Ky. riv.; can'l coal.
2647	Clay	1.10	35.60	63.30	36.70	56.90	6.40	0.885	Light spongy	Light brownish-grey	1.288	Isaac Jackson's, Left Fork Goose creek.
2648	Clay	1.20	38.10	60.70	39.30	54.90	5.80	1.793	Spongy	Lilac-grey	1.287	T. T. Garrard's, east side Goose creek.
2649	Clay	1.48	35.92	62.60	37.40	54.70	7.90	.885	Spongy	Light lilac-grey	1.278	Mrs. S A. White's, Salt Works Mine.
2650	Clay	1.46	34.84	63.70	36.30	57.70	6.00	.531	Spongy	Nearly white	1.292	J. L. Hornsby's, Laurel creek.
2651	Clay	.92	37.54	61.54	38.46	53.44	8.10	1.601	Spongy	Light brownish-grey	1.313	J. M. Jones', Beech creek, upper part.
2652	Clay	.42	32.38	67.20	32.80	35.20	32 00	6.042	Dense	Dark brown	not est.	J. M. Jones', Beech creek, lower part.
2653	Clay	2.80	29.40	67.80	32.20	57.00	10.80	1.178	Dense friable	Light brown	not est.	J. T. Smith's, Tom's Br.; bitum. layer.
2654	Clay	1.60	34.28	64.12	35.88	54.82	9.30	1.766	Dense spongy	Purplish-brown	1.290	Alvis Hubbard's, Katy's creek.
2655	Clay	.30	44.16	55.54	44.46	43.74	11.80	1.244	Dense	Dark grey	1.160	J. T. Smith's, Tom's Br.; cannel layer.
2667	Harlan	1.60	33.30	65.10	34.90	49.70	15.40	1.491	Spongy	Lilac-grey	not est.	Dale Bledsoe's 63-inch coal.
2668	Harlan	1.12	33.68	65.20	34.80	63.10	2.10	.440	Spongy	Light brownish-grey	not est.	3½ miles above m. of Clover Lick creek.
2669	Harlan	3.40	31.08	65.52	34.48	62.52	3.00	.365	Friable	Light purplish-grey	not est.	Right bank of Looney creek.
2670	Harlan	1.60	35.00	63.40	36.60	57.40	6.00	.558	Spongy	Reddish-brown	not est.	E. Dickson's, Tantrough Br. Poor Fork.
2671	Harlan	1.40	32.20	66.40	33.60	57.20	9.20	.742	Dense	Lilac-grey	not est.	On Tyrey's Branch of Clover Lick creek.
2672	Harlan	2.30	33.30	64.40	35.60	57.20	7.20	.502	Dense	Brown	not est.	J. Jenkins', Fickles' Cove of Looney cr.
2673	Harlan	2.50	34.30	63.20	36.80	58.70	4.50	.502	Dense friable	Brownish	not est.	On Right Branch of Looney's creek.
2674	Harlan	1.00	29.50	69.50	30.50	31.60	37.90	.613	Pulverulent	Brown	not est.	Garner's Hollow. J. L. Cornett's.

2675	Harlan	4.62	32.98	62.40	37.60	58.30	4.10	.475	Pulverulent	Very light brown	not est.	Garner's Spring, 15 m. ab. m. Poor Fork.
2676	Harlan	6.08	32.72	61.20	38.80	58.20	3.00	.311	Pulverulent	Light brown	not est.	Head Island Br. Poor Fork Cumb. river.
2677	Harlan	1.90	36.00	62.10	37.90	56.10	6.00	.461	Spongy	Light brown	not est.	Head Island Br. Poor Fork Cumb. river.
2678	Harlan	2.02	32.98	65.00	35.00	52.70	12.30	.546	Spongy	Light salmon		John L. Cornett's, near m. of Island Br.
2679	Harlan	1.76	34.64	63.60	36.40	60.50	3.10	.904	Light spongy	Very light grey		Geo. Turner's, Clover Fork Cumb. river.
2680	Harlan	1.60	37 70	60.70	39.30	54.84	5.86	.958	Light spongy	Light brown		Silas Woodson Kelly's, Yocum's creek.
2681	Harlan	1.04	21.88	77.08	22.92	29.60	47.48	5.436	Pulverulent	Purplish-brown		Bitum. shale, Sharpe's cr. of Yocum's cr.
2682	Harlan	1.50	35.30	63.20	36.80	60.24	2.96	1.041	Dense spongy	Brown		Coal sample 16, same bed, land J. Farley.
2683	Harlan	1.52	33.00	65.48	34.52	51.96	13.52	.684	Dense spongy	Light grey		Wright Winn's, Rt-hand Fk. Yocum's cr.
2684	Harlan	1.84	31.12	67.04	32.98	62.28	4.76	.794	Dense spongy	Light buff		J. Cornett's, Turkey-pen Br. Poor Fork.
2685	Harlan	1.58	31.82	66.60	33.40	63.20	3.40	1.288	Spongy	Brown		I. Creech's, Mud Lick Fk. Seagrave's cr.
2686	Harlan	6.18	34.24	59.58	40.42	52.88	6.70	.519	Pulverulent	Light buff		Childs' creek of Clover Fork.
2687	Harlan	2.20	33.52	64.28	35.72	55.72	8.56	.656	Dense friable	Light yellowish-grey		Childs' creek of Clover Fork.
2688	Harlan	1 80	35.00	63.20	36.80	57.30	5.90	.986	Dense spongy	Light greyish-brown		Buck Branch of Clover Fork.
2689	Harlan	1.80	33.60	64.60	35.40	55.20	9.40	.821	Spongy	Nearly white		Buck Branch Childs' cr. of Clover Fork.
2690	Harlan	2.46	31.94	65.60	34.40	61.20	4.40	.588	Dense	Light brown		Bailey Hollow of Clover Fork.
2691	Harlan	4.50	33.00	62.50	37.50	58.90	3.60	.628	Pulverulent	Salmon		Head Childs' cr.; sample upper 24 in. coal.
2692	Harlan	2.50	38.60	58.90	41.10	53.04	5.86	1.425	Spongy	Grey-brown		Head Childs' cr; sample of splint layer.
2693	Harlan	2.00	36.80	61.20	38.80	55.86	5.34	.958	Light spongy	Purplish-grey		Near head Childs' cr., same bed as 2686.
2694	Harlan	2.06	37.34	60.60	39.40	57.70	2.90	.579	Spongy	Purplish-grey		Right-hand Fork of Breeding creek.
2695	Harlan	1.80	37.10	61.10	38.90	56.70	4 40	.964	Light spongy	Purplish-grey		Elkaner Winn's, Branch of Clover Fork.
2696	Harlan	2.00	35.00	63.00	37.00	52.20	10.80	.959	Dense	Purplish-grey		Low Gap Br. Childs' cr.; samp. shop coal.
2697	Harlan	3.10	36.10	60.80	39.20	56.60	4 20	.794	Dense	Greyish-brown		Head of Laurel Fork of Seagrave's creek.
2698	Harlan	2.16	34.14	63.70	36.30	55.50	8.20	.684	Dense	Light grey		Low Gap Br. Childs' cr.; samp. splint coal.
2699	Harlan	1.68	35.72	62.60	37.40	60.20	2.40	.574	Dense	Light brownish-grey		Green Jones', near mouth Martin's Fork.
2700	Harlan	1.52	34.88	63.60	36.40	60.70	2.90	.615	Dense	Brownish-grey		Seagrave cr. of Clover Fork Cumb. river.
2701	Harlan	4 64	29.16	66.20	33.80	55.20	11.00	.986	Pulverulent	Light brownish-grey		Seagrave cr. of Clover Fork Cumb. river.
2702	Harlan	1.56	35.04	63.40	36.60	60.80	2.60	.835	Light spongy	Light brownish-grey		Fugit creek of Clover Fork.
2703	Harlan	1.56	42.64	55.80	44.20	46.48	9.32	.574	Dense	Greyish-brown		J. M. Smith's, Steep Hollow, Clover Fk.
2704	Harlan	1.74	31.76	66.50	33.50	57.10	9.40	.656	Dense spongy	Light grey		White Oak Branch of Yocum's creek.
2705	Harlan	1.56	35.24	63 20	36.80	58.00	5.20	.931	Friable	Very light grey		White Oak Br. Yocum's cr.; bot. same bed.
2706	Harlan	2.98	32.02	65 00	35.00	55.30	9.70	.692	Pulverulent	Light grey		Gray's Branch of Martin's Fork.
2707	Harlan	1.44	33.56	65.00	35.00	62.80	2.20	.849	Dense	Light brownish-grey		Frank's Branch of Yocum's creek.
2708	Harlan	1.26	29.20	69.54	30.46	56.68	12.86	.848	Dense spongy	Grey		J. L. Cornett's, Poor Fk.; av. sam. coking.
2709	Harlan	2.20	36.70	61.10	38.90	58.86	2.24	.277	Light spongy	Light brown		M. Hensley's, Wallen's cr.; av. sam. c'k'g.
2710	Harlan	1.30	37.10	61.60	38.40	58.24	3.36	1.290	Dense spongy	Light brownish-grey		F. F. Bronson's, Cl. L'k cr; av. sam. c'k'g.
2717	Johnson	1.44	50.22	48.34	51.66	40.74	7.60	.837	Dense	Light buff		W. Fletcher's cannel coal, Little Paint cr.
2718	Johnson	2.56	39.94	57.50	42.50	54.10	3.40	1.030	Spongy	Light buff		From same bed, bitum. or splint coal.
2719	Knott	6.48	29.78	63.74	36.26	60.64	3.10	.598	Pulverulent	Salmon		J. Amburgy's, Wolf Run; bitum. can. coal.
2720	Knott	.72	44.40	54.88	45.12	47.00	7.88	.753	Dense	Light buff		J. Amburgy's, Wolf Run; bitum. can. coal.
2721	Knox	1.20	38.80	60.00	40.00	58.86	1.14	.675	Spongy	Dark salmon		Noah Wiggins', Fighting cr., Cumb. riv.
2722	Knox	1.80	36.60	61.60	38.40	58.12	3.48	.884	Spongy	Light brown-grey		Sandy Branch, near Flat Lick.
2723	Knox	2.00	35.30	62.70	37.30	61.90	.80	.766	Dense spongy	Light brown		O. P. Ely's, Sandy Branch.
2724	Knox	1.20	35.08	63.72	36.28	58.92	4.80	.766	Light spongy	Very light brown		Pursifull seam, near Flat Lick.
2729	Laurel	.60	31.66	67.74	32.26	45.24	22.50	not est.	Dense	Dark purplish-grey		Cannel coal; Frederick Weidmer's.
2730	Laurel	2.56	34.56	62.88	37.12	59.58	3.30	.895	Spongy	Light grey		Pitman Coal Company's coal.
2733	Leslie	3.20	29.70	67.10	32.90	57.50	9.60	.626	Dense	Light brownish-grey	1.342	McClellan Schell's coal, Greasy creek.
2734	Leslie	1.72	35.68	62.60	37.40	51.20	11.40	1.367	Light spongy	Light purplish-grey	1.363	Nicholas Schell's coal, Greasy creek.
2735	Leslie	1.72	35.02	63.26	36.74	57.60	5.66	.599	Spongy	Light brownish-grey	1.251	Lewis Branch's coal, Greasy creek.
2736	Leslie	9.40	32.20	58.40	41.60	48.80	9.60	.433	Pulverulent	Nearly white	1.509	Head of Pace Trace, White Oak creek.
2737	Leslie	.74	36.06	63.20	36.80	54.00	9.20	1.307	Spongy	Grey-brown	1.279	Wm. Sisemore's, Rockhouse creek.
2738	Leslie	.70	34.70	64.60	35.40	55.20	9.40	.983	Spongy	Light purplish-grey	1.291	Jesse Morgan's, Middle Fork Ky. river.

TABLE I.—(Continued.)—COALS.—(Air Dried.)

Number	County.	Hygroscopic moisture	Volatile combustible matters	Coke.	Total volatile matters	Fixed carbon in the coke	Ash.	Sulphur	Character of the coke.	Color of the Ash.	Specific gravity	Remarks.
2739	Leslie	1.10	44.20	54.70	45.30	43.70	11.00	.690	Dense	Grey-brown	not est.	Jerry Ledington's cannel coal, Beech Fk.
2740	Leslie	1.60	34.94	63.46	36.54	55.46	8.00	1.066	Spongy	Lilac-grey	1.322	W. McFadden's, Big cr., Red Bird creek.
2741	Leslie	1.40	35.68	62.92	37.08	58.92	4.00	.667	Light spongy	Light reddish-grey	1.285	Richard Collins', Hal's Fork, Big creek.
2742	Leslie	1.80	34.14	64.06	35.94	57.86	6.20	.613	Dense	Light lilac-grey	1.321	Asper's bank, Middle Fork Ky. river.
2743	Leslie	1.30	32.36	66.34	33.66	50.34	16.00	1.409	Dense spongy.	Lilac-grey	1.502	Silas Nantz', Oldham Br. Middle Fork.
2744	Letcher.	2.40	32.60	65.00	35.00	62.44	2.56	.492	Dense friable	Light salmon	not est.	Rt.-hand Br. Rt.-hand Fork Collier's cr.
2745	Letcher.	1.40	33.40	65.20	34.80	59.08	6.12	1.426	Spongy	Light grey	not est.	Wm. Lewis', Roland's Br. of Poor Fork.
2765	Martin	2.92	34.98	62.10	37.90	55.30	6.80	.681	Dense spongy	Light buff	1.344	Rockcastle Min. & L. Co., R'ckcastle cr.
2766	Martin	2.62	27.98	69.40	30.60	50.40	19.00	.736	Friable	Light grey	1.451	Rockcastle Min. & L. Co., R'kcastle cr.
2783	Perry.	3.50	35.30	61.20	38.80	53.14	8.06	1.035	Dense	Light brownish-grey	1.333	John Field's coal.
2784	Perry.	.80	44.80	54.40	45.60	37.60	16.80	.970	Pulverulent	Grey-brown	not est.	Cannel coal, Middle Fork Ky. river.
2785	Perry.	1.20	39.60	59.20	40.80	52.70	6.50	1.327	Spongy	Light lilac-grey	1.279	Wm. Boling's, Rush Br. Middle Fork.
2786	Perry.	1.20	35.90	62.90	37.10	55.30	7.60	.654	Light spongy	Nearly white	1.300	Wm. Boling's, Rush Br Middle Fork.
2787	Perry.	5.26	30.34	64.40	35.60	55.20	9.20	.475	Friable	Light purplish-grey	1.359	Fish-trap Br. of North Fork of Ky. river.
2788	Perry.	3.30	34.90	61.80	38.20	52.20	9.60	.763	Dense friable	Purplish-grey	1.334	T. J. Johnson's, Ebersole Br. Middle Fk.
2789	Perry.	4.36	30.34	65.30	34.70	54.90	10.40	.450	Friable	Very light grey	1.366	John Spencer's, Grapevine creek.
2790	Perry.	3.40	31.00	65.60	34.40	55.30	10.30	.537	Friable	Very light grey	1.366	Mouth of Guy's creek.
2791	Perry.	6.48	30.32	63.20	36.80	47.80	15.40	.491	Pulverulent	Very light grey	not est.	John Spencer's, Grapevine creek.
2792	Perry.	2.80	29.60	67.60	32.40	58.50	9.10	.505	Friable	Purplish-grey	not est.	Joseph Campbell's, mouth Rock Lick Br.
2793	Perry.	1.76	36.04	62.20	37.80	56.20	6.00	.557	Light spongy	Very light grey	1.290	Alex. Combs', North Fork of Ky. river.
2794	Perry.	3.96	32.84	63.20	36.80	52.80	10.40	.722	Friable	Purplish-grey	1.390	Samuel Whittaker's, Willard creek.
2795	Perry.	1.90	37.10	61.00	39.00	57.90	3.10	.749	Spongy	Light purplish-grey	1.259	Peter Gross', near Squabble creek.
2796	Pulaski.	2.32	32.48	65.20	34.80	59.10	6.10	1.077	Spongy	Light grey	not est.	Barren Fork.
2797	Pulaski.	2.12	31.56	66.32	33.68	59.02	7.30	1.879	Spongy	Yellowish-grey	not est.	Barren Fork, nut coal.
2799	Whitley	1.84	33.84	64.32	35.68	59.96	4.36	2.180	Light spongy	Lilac	1.303	Possum Branch of Wolf creek.
2800	Whitley	2.00	31.30	66.70	33.30	62.94	3.76	.901	Light spongy	White	1.285	Forks of Jellico creek, Salt Works.
2801	Whitley	2.40	35.80	61.80	38.20	58.96	2.84	.556	Light spongy	Brownish-grey	1.282	Right Fork of Bennett's creek.
2802	Whitley	2.14	39.76	58.10	41.90	55.06	3.04	.892	Light spongy	Brownish-grey	1.279	Right Fork of Patterson creek.
2803	Whitley	1.90	36.10	62.00	38.00	59.50	2.50	.997	Spongy	Light brownish-grey	1.271	W. Jones' coal, Briar creek.
2804	Whitley	1.90	37.40	60.70	39.30	58.60	2.10	.928	Spongy	Light brownish-grey	1.281	Henry Green's coal, Briar creek.
2805	Whitley	1.94	38.92	59.14	40.86	56.84	2.30	.764	Spongy	Light brownish-grey.	1.414	Richardson's coal, Briar creek.
2806	Whitley	2.14	36.06	61.80	38.20	59.20	2.60	.755	Spongy	Light brownish-grey.	1.262	M. A. Jones' coal, head of Patterson cr.
2807	Whitley	2.40	36.60	61.00	39.00	57.70	3.30	.708	Dense spongy	Light brownish-grey.	1.277	Tackett's creek; Terrel Siler's coal.
2808	Whitley	2.20	33.10	64.70	35.30	56.80	7.90	4.234	Light spongy	Dark purplish	1.321	Mahan Station.
2809	Whitley	2.20	34.86	62.94	37.06	58.14	4.80	1.340	Spongy	Brownish-grey	1.271	Mahan's coal, Mahan Station.
2810	Whitley	1.80	36.70	61.50	38.50	58.50	3.00	1.093	Spongy	Light purplish-grey	1.311	W. M. Mahan's coal, Mahan Station.
2811	Whitley	1.50	40.56	57.94	42.06	51.24	6.70	2.768	Dense spongy.	Dark greyish-purple.	1.359	Caddell's coal, Wolf creek.
2812	Whitley	7.26	33.84	58.90	41.10	53.20	5.70	.640	Pulverulent	Grey-brown	1.387	Thomas' cannel coal.

2813	Whitley . .	1.70	37.40	60.90	39.10	59.36	1.54	1.721	Spongy	Light purplish-grey .	1.263	Lower part of Creedmore coal.
2814	Whitley . .	2.24	35.66	62.10	37.90	58.76	3.34	1.060	Light spongy .	Salmon	1.341	B. P. Shelby's coal, upper 26 inches.
2815	Whitley . .	2.58	33.12	64.30	35.70	62.70	1.60	.670	Light spongy .	Light brown	1.293	Wagner Siler's, on Mud creek.
2816	Whitley . .	2.00	34.82	63.18	36.82	60.48	2.70	.629	Light spongy .	Light brownish-grey.	not est.	J. S. Berry's, Jellico seam.

WEST VIRGINIA COALS.—(Air Dried.)

Number . . .	County.	Hygroscopic moisture . .	Volatile combustible matters.	Coke.	Total volatile matters . . .	Fixed carbon in the coke .	Ash.	Sulphur	Character of the coke.	Color of the Ash.	Specific gravity.	Remarks.
2818	Wise	0.86	38.54	60.60	39.40	47.84	12.76	0.711	Dense friable .	Chocolate brown . .	not est.	Three miles above mouth of Preacher cr.
2819	Fayette . . .	.40	18.00	81.60	18.40	79.00	2.60	.491	Much inflated .	Light brownish-grey.	not est.	Quinnimont mines.
2820	Fayette . .	.60	20.80	78.60	21.40	75.34	3.26	.418	Light spongy .	Light buff-grey . . .	not est.	Fire creek.
2821	Fayette. . .	.60	22.80	76.60	23.40	74.20	2.40	.491	Light spongy .	Light buff-grey . . .	not est.	Stone Cliff.
2822	Fayette. . .	.90	19.10	80.00	20.00	73.60	6.40	.848	Light spongy .	Light buff-grey . . .	not est.	Stone Cliff.
2823	Fayette. . .	.80	22.14	77.06	22.94	74.46	2.60	.464	Much inflated .	Light brownish-grey.	not est.	Sewell, on top of the conglomerate.
2824	Fayette. . .	1.06	32.34	66.60	33.40	62.00	4.60	.629	Spongy	Light buff-grey . . .	not est.	Hawknest.

APPENDIX.

TABLE I.—COMPOSITION OF COALS.—(Air Dried.)—Continued.

Number	County.	Hygroscopic moisture	Volatile combustible matters	Coke.	Total volatile matters	Carbon in coke.	Ash.	Character of the coke.	Color of the Ash.	Sulphur	Remarks.
2833	Bell	1.40	37.10	61.50	38.50	56.30	5.20	Dense spongy.	Brown	1.151	John Slusher's, Straight creek.
2834	Bell	.60	35.00	64.40	35.60	61.90	2.50	Very dense	Light grey-brown	1.068	James Green's coal.
2835	Bell	1.20	32.20	66.60	33.40	61.60	5.00	Inflated	Brownish-grey	.574	James Green's coal.
2836	Bell	1.00	35.40	63.60	36.40	61.70	1.90	Inflated	Light salmon-colored	.629	James Green's coal.
2837	Bell	1.70	32.60	65.70	34.30	63.30	3.40	Spongy	Light grey-brown	.684	Fifteen miles above Pineville.
2838	Bell	1.00	51.60	47.40	52.60	40.40	7.00	Dense	Brown	.739	Fifteen miles above Pineville.
2839	Bell	.80	33.90	65.30	34.70	59.90	5.40	Light spongy	Grey-brown	1.508	James Bissell's, Cannon creek.
2840	Bell	5.40	30.00	64.60	35.40	60.50	4.10	Pulverulent	Dark salmon-colored	.436	Feelan Risner's coal, on Browney's creek.
2841	Bell	1.60	47.40	51.00	49.00	47.70	3.30	Pulverulent	Dark brown	.574	
2842	Bell	1.60	33.20	65.20	34.80	60.60	4.60	Light spongy	Light grey-brown	.876	Head of Middle Fork Williams Br. Yellow creek.
2843	Bell	1.40	32.30	66.30	33.70	63.50	2.80	Dense	Light grey-brown	.670	On land of J. M. Robbins, Crane creek of Yellow creek.
2844	Bell	1.20	34.90	63.90	36.10	62.10	1.80	Spongy	Salmon-colored	.529	
2845	Bell	.80	35.30	63.90	36.10	60.20	3.70	Spongy	Light grey-brown	.425	John M Marricle's, Cubbog creek.
2846	Bell	2.20	32.60	65.20	34.80	61.80	3.40	Pulverulent	Salmon-colored	.601	Richard Risner's, Hansee's creek.
2847	Bell	4.10	29.90	66.00	34.00	61.80	4.20	Dense friable	Salmon-colored	.739	Andrew Marricle's, Cubbog creek.
2848	Bell	2.60	33.20	64.20	35.80	59.60	4.60	Dense spongy	Light brown	.931	Stone Coal Branch of Browney's creek.
2849	Bell	1.40	34.60	64.00	36.00	61.80	2.20	Dense spongy	Dark salmon-colored	.821	Near head of Browney's creek.
2860	Bell	2.00	34.60	63.40	36.60	60.40	3.00	Dense	Light brown	.507	On Four-mile creek of Cumberland river.
2851	Bell	4.40	29.50	66.10	33.90	60.50	5.60	Very dense	Brownish-grey	.978	One and a half miles on Four-mile creek.
2852	Bell	4.60	28.80	66.60	33.40	63.60	3.00	Pulverulent	Light brown	.506	On Four-mile creek.
2853	Bell	7.60	28.94	63.46	36.54	55.26	8.20	Pulverulent	Light brown	.603	On Four-mile creek.
2854	Bell	1.44	32.56	66.00	34.00	53.34	12.66	Dense spongy	Purplish-grey	1.454	Shade Branch of Bennett's Fork of Yellow creek.
2855	Bell	6.70	30.10	63.20	36.80	49.80	13.40	Pulverulent	Brownish-grey	1.125	Head of Steward's Branch.
2856	Bell	0.30	29.76	69.94	30.06	55.74	14.20	Dense	Light purplish-grey	2.965	Head of Steward's Branch.
2857	Bell	1.40	35.34	60.26	36.74	60.26	3.00	Inflated	Very light brown	....	Above head of Kit Island Branch of Straight cr.
2863	Harlan	3.00	31.40	65.60	34.40	56.30	9.30	Dense	Light buff-grey	.604	Head of Luna's creek.
2864	Harlan	1.66	42.80	55.54	44.46	35.44	20.10	Pulverulent	Light grey-brown	.549	Head of Catteran's creek of Martin's Fork.
2865	Harlan	1.86	30.74	67.40	32.60	65.00	2.40	Spongy	Light brown	.493	Head of Catteran's creek of Martin's Fork.
2866	Harlan	1.74	33.32	64.94	35.06	59.24	5.70	Spongy	Light brown	1.034	John Bell's Branch of Catteran's creek.
2867	Harlan	2.50	31.90	65.60	34.40	61.80	3.80	Dense	Light brown	.438	Catteran's creek of Martin's Fork.
2868	Harlan	.80	37.30	61.90	38.10	54.90	7.00	Dense spongy	Purplish-brown	1.925	Two lower seams, same bed.
2869	Harlan	1.40	32.00	66.60	33.40	62.30	4.30	Dense spongy	Light brown	.712	Trace Branch of Clover creek.
2870	Harlan	3.60	29.40	67.00	33.00	57.00	10.00	Pulverulent	Light grey	.622	Slick Rock Branch of Clover creek.
2871	Harlan	.90	34.30	64.80	35.20	62.50	2.30	Inflated	Light grey-brown	.577	Terry's Branch of Wallen's creek.

2872	Harlan . . .	.90	30.10	69.00	31.00	42 40	26.60	Dense friable .	Light purplish-grey .	1.084	Terry's Branch of Wallen's creek.
2873	Harlan . . .	4.00	31.00	65.00	35.00	56.00	9.00	Friable	Grey-brown	1.027	Head of Puckett's creek.
2874	Harlan . . .	2.40	34.20	63.40	36.60	60.60	2.80	Dense spongy.	Grey-brown.	.684	Head of Puckett's creek.
2875	Harlan . . .	1.80	34.20	64.00	36.00	60.10	3.90	Dense spongy.	Brownish-grey . . .	.917	Head of Puckett's creek.
2876	Harlan . . .	2.00	33.40	64.60	35.40	61.60	3.00	Very dense . .	Light salmon-colored	.643	Martin's Fork of Cumberland river.
2877	Harlan . . .	1.10	32.90	66.00	34.00	63.40	2.60	Very dense . .	Dark salmon-colored	.519	Black Mountain, Martin's Fork, Cumb'l'd river.
2878	Harlan . . .	1.20	33.00	65.80	34.20	61.80	4.00	Dense spongy.	Grey-brown	.628	Broad Branch of Martin's Fork.'
2879	Harlan . . .	1.20	35.10	63.70	36.30	57.10	6.60	Dense	Grey-purplish. . . .	1.906	On Crumbie's Branch of Martin's Fork.
2880	Harlan . . .	3.20	33.60	63.20	36.80	56.80	6.40	Very dense . .	Light brown	1.782	On G. W. Smith's land, Crank's creek.
2881	Harlan . . .	2.80	32.00	65.20	34.80	62.80	2.40	Dense	Light brown	.354	On Crank's creek.
2882	Harlan . . .	1.90	28.90	69.20	30.80	61.10	8.10	Spongy	Light grey-brown . .	.486	Head of Luna's creek, Poor Fork.
2883	Harlan . . .	3.20	28.06	68.74	31.26	60.44	8.30	Dense friable .	Light brown	.541	Head of Camp Fork, Luna's creek.
2884	Harlan . . .	2.10	32.90	65.00	35.00	56.60	8.40	Dense	Light brownish-grey.	.774	Head of Rockhouse Branch of Luna's creek.
2885	Harlan . . .	2.20	33.80	64.00	36.00	61.00	3.00	Dense spongy.	Very light brown . .	.552	Near mouth of Luna's creek.
2886	Harlan . . .	5.70	32.90	61.40	38.60	58.80	2.60	Light spongy .	Very light brown . .	.425	Near mouth of Luna's creek. (Elkhorn bed.)
2887	Harlan . . .	9.60	33.80	60.20	39.80	50.12	10.08	Pulverulent . .	Nearly white	.560	Near mouth of Luna's creek.
2888	Harlan . . .	1.80	31.60	66.60	33.40	63.20	3.40	Light spongy .	Light brown	1.181	Cold Iron Branch of Poor Fork, Cumb'land river.
2889	Harlan . . .	2.40	31.70	65.90	34.10	63.70	2.20	Dense spongy.	Light brown	.312	Cold Iron Br. Poor F. Cumb. riv. (Elkhorn bed.)
2890	Harlan . . .	2.30	31.50	66.20	33.80	61.60	4.60	Spongy	Light brownish-grey.	.560	Turkey-pen Branch, Poor Fork.
2892	Knox . . .	.40	37.20	62.40	37.60	56.46	5.94	Light spongy .	Light grey	.820	Golden Fork of Poplar creek.
2893	Laurel . . .	3.40	33.80	62.80	37.20	58.80	4.00	Dense spongy .	Nearly white	.930	S. W. Owsley's coal.
2894	Laurel . . .	2.70	34.60	62.70	37.30	59.70	3.00	Spongy	Light grey	1.923	Near Siley; bed 46 inches thick.
2900	Muhlenberg.	2.66	36.74	60.60	39.40	42.20	18.40	Spongy	Dark brown	7.527	Cannel coal (?) near western border of county.
2903	Whitley. . .	2.46	34.14	63.40	36.60	57.80	5.60	Spongy	Brownish-grey . . .	.848	On Harp's creek; Bennett's coal; upper 2 feet.
2904	Whitley. . .	1.60	34.00	64.40	35.60	56.80	7.60	Spongy	Light grey	.820	On Harp's creek; Bennett's coal; lower 3 feet.
2907	Whitley. . .	2.00	33.70	64.30	35.70	61.90	2.40	Light spongy .	Light brownish-grey.	.796	Procter Company coal mine, whole bed.
2908	Whitley. . .	2.60	33.20	64.20	35.80	62.20	2.00	Light spongy .	Light grey-brown . .	.769	Procter Company coal mine, lower seam.
2909	Whitley. . .	1.80	35.00	63.20	36.80	60.60	2.60	Light spongy .	Very lt. brown'h-grey	.714	Procter Company coal mine, upper bench.

TENNESSEE COALS.—(Air Dried.)

Number . . .	County.	Hygroscopic moisture . .	Volatile combustible matters.	Coke.	Total volatile matters . . .	Carbon in the coke	Ash.	Character of the coke.	Color of the Ash.	Sulphur . . .	Remarks.
2905	Claiborne . .	2.10	34.24	63.66	36.34	55.26	8.40	Dense	Light purplish-grey .	1.427	Head of Little Coal Branch of Tackett's creek.
2906	Claiborne . .	7.00	30.90	62.10	37.90	58.30	3.80	Pulverulent . .	Light brownish-grey .	.685	Mouth of Big Sugar Branch of Bennett's Fork.

TABLE II.—COKES.—(Air Dried.)

Number . . .	County.	Moisture expelled at red heat	Carbon in the coke	Ash.	Sulphur . . .	Color of the Ash.	Owner of the Coal.	Hours of coking	Remarks.
2589	Bell	0.80	93.90	5.30	1.480	Dark brown	F. Barnet	42	Made at Birmingham, Alabama.
2590	Bell	.20	95.80	4.00	1.710	Dark brown	F. Barnet	48	Made at Quinnimont, West Virginia.
2591	Bell	.50	94.50	5.00	.959	Dark brown	F. Barnet	72	Made at Quinnimont, West Virginia.
2592	Bell	1.80	87.20	11.00	1.343	Light brown	Jas. Barnett.	42	Made at Birmingham, Alabama.
2593	Bell	.60	87.80	11.60	1.590	Reddish-brown	Jas. Barnett.	48	Made at Quinnimont.
2594	Bell	.40	89.20	10.40	1.590	Greyish-brown	Jas. Barnett.	72	Made at Quinnimont.
2595	Bell	1.30	88.90	9.80	1.346	Brownish-grey	Jas. Barnett.	48	Made at Quinnimont.
2596	Bell	2.40	85.30	12.30	1.543	Chocolate-brown	Jas. Myers	42	Made at Birmingham, Alabama.
2597	Bell	.40	90.80	8.80	.547	Light grey-brown	Jas. Myers	72	Made at Quinnimont, West Virginia.
2598	Bell	.10	91.50	8.40	.794	Light grey-brown	Jas. Myers	48	Made at Quinnimont, West Virginia.
2599	Bell	.20	94.20	5.60	.601	Brown	D. Howard	42	Made at Birmingham, Alabama.
2600	Bell	1.60	89.60	8.80	.491	Light brown	Alf. McTee	42	Made at Birmingham, Alabama.
2601	Bell	.70	92.70	6.60	.450	Brownish-grey	Alf. McTee	. .	Made at Birmingham, Alabama.
2602	Bell	.40	94.00	5.60	.629	Brownish-grey	Alf. McTee	72	Made at Quinnimont, West Virginia.
2603	Bell	.26	92.94	6.80	1.033	Light brown	W. D. King	42	Made at Birmingham, Alabama.
2604	Bell	.66	90.54	8.80	1.150	Reddish light brown	W. D. King	48	Made at Quinnimont.
2605	Bell	.20	92.20	7.60	.491	Brown-grey	W. D. King	72	Made at Quinnimont.
2606	Bell	1.00	92.80	6.20	.603	Light brown	M. Dorton	42	Made at Birmingham
2607	Bell	.90	92.70	6.40	1.975	Nearly white	Dean seam	72	Made at Quinnimont.
2608	Bell	1.80	90.50	7.70	.684	Light brown-grey	Dean seam	72	Made at Quinnimont.
2711	Harlan	.60	93.10	6.30	.546	Brownish-grey	Wallen's creek	48	Made at Quinnimont, West Virginia.
2712	Harlan	1.34	80.76	17.90	.648	Light grey	J. L. Cornett	72	Made at Quinnimont, West Virginia.
2713	Harlan	.40	93.00	6.00	1.068	Grey-brown	S: S. Branson	72	Made at Quinnimont, West Virginia.
2714	Harlan	.90	92.90	6.20	.368	Grey-brown	Wallen's creek	72	Made at Quinnimont, West Virginia.
2725	Knox	.90	95.90	3.20	.546	Reddish-brown	N. Wiggins	72	Made at Quinnimont, West Virginia.
2726	Knox	.40	93.70	5.90	.478	Brownish-grey	Sandy Branch	48	Made at Quinnimont, West Virginia.
2727	Knox	.50	96.00	3.50	.217	Brown	O. P. Ely	72	Made at Quinnimont, West Virginia.
2728	Knox	.90	90.70	8.40	.546	Brownish-grey	Pursifull	72	Made at Quinnimont, West Virginia.
2730a	Laurel	.50	92.60	6.90	.615	Brownish-grey	Pitman Coal Company	72	Made at Quinnimont, West Virginia.
2746	Letcher	.70	89.30	10.00	.863	Light grey-brown	Wilson Lewis	72	Made at Quinnimont, West Virginia.
2817	Whitley.	1.50	93.30	5.20	.382	Brownish-grey	J. S. Berry's	72	Made at Quinnimont, West Virginia.

TABLE II.—(Continued.)—WEST VIRGINIA COKES.—(Air Dried.)

Number . . .	County.	Moisture expelled at red heat	Carbon in the coke	Ash.	Sulphur . . .	Color of the Ash.	Kind of Coal.	Hours of coking.	Remarks.
2825	Fayette.	2.20	92.00	5.80	0.491	Brownish-grey	. . . .	48	Made at Quinnimont, March 22-24, 1886.
2826	Fayette.	.40	90.50	9.10	.711	Light grey-brown . . .	Hawknest	. . .	Made at Quinnimont, in Solendorf Coppe oven.
2827	Fayette.	1.70	92.90	5.40	.401	Brownish-grey	Fire creek	48	Made at Quinnimont, March 26th, 1886.
2828	Fayette.	.86	92.74	6.40	.437	Light buff-grey	Fire creek	48	Made at Quinnimont, March 16th, 1886.
2829	Fayette.	.36	96.40	3.24	.519	Light reddish-brown. .	Fire creek	48	Made at Quinnimont, March 16th, 1886.
2330	Fayette.	1.60	89.80	8.60	.821	Light grey-brown . . .	Fire creek	72	Made at Quinnimont, March 16th, 1886.
2831	Fayette.	.50	92.90	6.60	.560	Light brownish-grey . .	Sewell	48	Made at Quinnimont, March 27th, 1886.
2832	Fayette.	1.60	91.80	6.60	.478	Light brown-grey . . .	Sewell	72	Made at Quinnimont, March 27th, 1886.

APPENDIX.

Number	County	Moisture expelled at red heat	Carbon in the coke	Ash	Sulphur	Color of the Ash	Remarks
2899	Muhlenberg.	0.20	90.20	9.60	1.260	Purplish-grey.	Made from coal three-quarters of a mile northwest of Mud River coal mines.

TABLE V.—IRON ORES.—(Air Dried.)

Number . . .	County.	Iron peroxide.	Alumina . . .	Lime carbonate.	Magnesia carbonate. . .	Phosphoric acid (P_2O_5)	Silica.	Water expelled at 212° F. .	Carbonic acid, water, &c.	Per cent. of iron.	Remarks.
2575	Bath	47.630	5.468	16.560	9.974	1.202	7.160	1.143	10.863	33.341	Clinton group ore, Captain W. G. Allen's property.
2576	Bath	51.430	5.132	13.080	9.444	1.138	7.800	.693	11.283	36.001	Clinton group ore, from the Purvis lands.
2577	Bath	58.570	3.720	15.160	4.528	1.010	6.960	1.607	8.445	40.999	Clinton group ore, from land of William Warren, Rose run.

APPENDIX.

Number	County	Iron peroxide	Alumina	Lime carbonate	Magnesia carbonate	Phosphoric acid (P_2O_5)	Silica	Water expelled at 212° F.	Carbonic acid, water, &c.	Per cent. of iron	Remarks
2857a	Bell.	60.517	5.723	traces.		0.259	23.940	9.561		42.362	On N. face of Pine Mt., 3½ miles E. of Pineville. (6-8 in.) Oriskany ore.
2891	Harlan . . .	44.200	9.080	20.000	4.238	2.726	12.600	7.156		39.940	On Poor Fork of Cumberland river, 27 miles above Harlan Court-house.
2901	Pike	66.370	12.270	.200	trace.	3.040	2.600	15.520		46.46	Collected by C. M. Parsons.

TABLE III.—SOILS AND SUBSOILS.—(Calculated Dried at 212° F.)

Number . . .	County.	Organic and volatile matters	Alumina and manganese oxide. . . .	Iron peroxide.	Lime carbonate	Magnesia . . .	Phosphoric acid (P_2O_5).	Potash	Soda	Water expelled at 380-400° F.	Sand and insoluble silicates	Hygroscopic moisture . .	Potash in silicious residue.	Soda in silicious residue.	Fine sand. . .	Remarks.
2556	Ballard . .	3.306	2.945	1.860	0.196	.181	.008	.477	.389	0.556	90.616	1.100	1.497	0.834	16.500	Crawfishy soil, on Mayfield creek.
2557	Ballard . .	5.772	6.876	4.124	.210	.273	.226	.723	.145	1.263	80.999	2.290	1.069	.277	n. e.	Virgin Ohio river bottom soil.
2558	Ballard . .	4.635	4.217	1.915	1.463	.267	.133	.504	n. e.	.941	86.856	1.625	1.435	1.243	. . . .	Virgin Obion river bottom soil.
2559	Ballard . .	3.096	3.065	1.907	.096	.134	.062	.420	n. e.	.571	90.696	1.175	1.476	n. e.	. . . .	Virgin upland soil, from the "Barrens."
2560	Ballard . .	2.079	4.613	2.478	.071	.202	.052	.836	n. e.	.425	90.219	1.180	1.229	1.032	. . . .	Subsoil of next preceding.
2561	Ballard . .	3.642	4.639	2.363	.071	.198	.103	.295	.248	.842	87.952	1.430	1.439	1.208	. . . .	Virgin soil, Flatwood loam.
2562	Ballard . .	2.114	4.523	3.077	.046	.344	.115	.422	.136	.648	88.866	1.375	1.591	1.551	. . . .	Subsoil of next preceding.
2563	Ballard . .	3.510	3.906	2.112	.146	.289	.100	.419	.260	1.038	88.394	1.300	1.415	.257	. . . .	Virgin soil, dark loam.
2564	Ballard . .	2.364	4.602	2.870	.086	.222	.126	.674	n. e.	.698	88.766	1.235	1.389	n. e.	. . . .	Subsoil of next preceding.
2565	Ballard . .	1.961	1.907	1.403	.071	.124	.094	.250	.236	.553	93.385	.600	.997	.567	44.650	Red sandy soil of Sandy Ridge.
2566	Ballard . .	3.733	2.130	1.519	.349	.175	.095	.265	.057	1.604	90.303	1.300	1.859	1.025	. . . .	Virgin, dark bluff, loam soil.
2567	Ballard . .	1.281	3.268	2.224	.146	.234	.078	.109	.023	.958	91.067	.900	2.031	.927	. . . .	Subsoil of the next preceding.
2621	Calloway .	3.475	3.612	2.116	.021	.180	.062	.310	n. e.	1.100	88.432	1.450	1.146	.535	. . . .	Virgin soil, Clark's river bottom.
2622	Calloway .	6.080	8.171	4.791	.280	.461	.218	.461	n. e.	2.135	77.719	2.650	1.487	.253	. . . .	Virgin soil, 1st bottom, Tennessee river.
2623	Calloway .	3.540	3.190	2.862	.096	.125	.093	.084	.119	1.060	88.883	1.150	1.572	.331	. . . .	Virgin soil, Big Barrens.
2624	Calloway .	2.632	5.239	4.234	.096	.107	.084	.389	n. e.	.860	86.106	1.250	1.378	.792	. . . .	Subsoil of next preceding.
2625	Calloway .	2.862	3.321	2.968	trace.	.234	.062	.369	n. e.	.824	89.353	.950	1.245	.374	. . . .	Virgin soil, upland.
2626	Calloway .	2.569	4.920	4.145	.046	.215	.062	.151	.097	.755	86.342	1.125	1.264	.339	. . . .	Subsoil of next preceding.
2627	Calloway .	5.482	3.595	3 060	.147	.245	.124	.246	n. e.	1.401	84.792	1.500	1.469	.267	. . . .	Virgin soil, 2d bottom, Tennessee river.
2628	Calloway .	2.627	5.333	4.365	.220	.180	.124	.517	n. e.	.859	86.200	1.050	1.360	.694	. . . .	Subsoil of next preceding.
2629	Calloway .	3.000	4.395	3.711	.146	.217	.094	.238	.029	.834	88.122	1.100	1.307	.411	. . . .	Virgin upland soil.
2630	Calloway .	2.497	1.924	2.020	.131	.118	.094	.035	n. e.	.453	92.631	.875	1.605	.424	. . . .	Virgin upland sandy loam. (Coalings.)
2631	Calloway .	2.999	4.725	4.250	.041	.273	.094	.256	n. e.	.609	86.522	1.650	1.866	.274	. . . .	Subsoil of next preceding.
2632	Calloway .	2.650	1.989	2.564	.652	.089	.076	.068	n. e.	.657	91.345	1.150	1.090	.455	. . . .	Virgin soil, Post Oak Flatwoods.
2633	Calloway .	2.188	2.809	2.836	.096	.153	.094	.127	n. e.	.522	90.900	1.300	1.093	.439	. . . .	Subsoil of next preceding.
2634	Calloway .	5.848	4.982	2.455	.163	.378	.249	.259	n. e.	1.323	84.356	1.850	1.268	.309	. . . .	Virgin bottom soil, Shannon creek.
2635	Calloway .	3.500	4.332	5.575	.132	.364	.159	.604	n. e.	.814	84.426	1.700	1.386	.588	. . . .	Subsoil of next preceding.
2660	Graves . .	2.639	2.636	1.756	.096	.159	.084	.149	n. e.	.696	91.295	.915	1.732	1.461	. . . .	Virgin soil, Black Jack Oak Barren.
2661	Graves . .	2.187	3.511	2.484	.147	.235	.049	.110	.039	1.156	89.813	.575	1.827	.870	. . . .	Subsoil of next preceding.
2716	Jefferson .	5.100	10.524	3.795	.140	.458	.176	.191	.201	1.000	78.950	1.700	1.855	.229	. . . .	Surface (mucky) soil, Geo. Crum's.
2747	Marshall .	3.443	3.303	1.955	.025	.162	.136	.047	n. e.	.607	90.217	1.300	1.544	1.418	0.150	Virgin soil, Crawfish Flats, Tenn. river.
2748	Marshall .	2.373	5.021	2.630	trace.	.139	.110	.515	n. e.	.227	88.877	1.100	.515	.153	3.150	Subsoil of next preceding.
2749	Marshall .	3.757	3.706	1.360	.026	.143	.109	.083	.210	.583	90.070	1.520	1.438	.402	3.725	Virgin soil, bottom land, Clark's river.
2750	Marshall .	3.845	4.623	3.039	.076	.181	.127	.477	.084	.224	87.057	1.800	1.284	.526	1.050	Virgin soil, Post Oak Flats, Clark's riv.
2751	Marshall .	3.467	4.875	2.332	.046	.194	.113	.192	n. e.	.531	88.460	1.225	1.600	.598	1.500	Virgin soil, low ridge, Tenn. riv. valley.
2752	Marshall .	3.506	3.030	2.037	trace.	.281	.110	.305	.046	.509	89.643	1.900	1.506	.312	1.825	Virgin soil, glady, of Tennessee Valley.
2753	Marshall .	4.411	4.448	3.395	trace.	.344	.094	.160	n e.	.557	86.678	1.400	1.614	.598	trace.	Virgin soil, loam soil, low ridge, Tenn. r.
2754	Marshall .	2.949	3.671	2.077	.046	.226	.046	.117	n. e.	.974	89.452	1.300	1.434	.542	. . . .	Virgin soil, Flatwood, on Harvey road.
2755	Marshall .	2.330	4.037	2.667	.046	.327	.014	.079	.048	.794	89.453	1.300	1.462	.430	. . . .	Subsoil of next preceding.
2756	Marshall .	2.129	3.875	2.930	.045	.309	n. e.	.179	n. e.	.841	88.884	1.850	1.631	.636	trace.	White silty soil, Clark's river.

2757	Marshall . .	3.394	3.248	1.764	0.146	.180	.084	.172	n. e.	1.028	89.757	1.300	1.604	0.609	n. e.	Bottom soil, Clark's rivet.
2767	McCracken	4.385	7.307	3.094	.215	.046	.110	.271	.119	909	83.233	2.750	1.215	.480	. . . .	Oak and hickory flat lands.
2768	McCracken.	3.781	6.578	3.416	.164	.047	.085	.227	.032	.488	84.790	2.825	1.343	.500	. . . .	Subsoil of next preceding.
2769	McCracken.	3.549	3.160	1.681	.197	.327	.096	.329	.583	.547	90.050	1.265	1.621	1.050	. .	Virgin, brown loam, s. w. of county.
2770	McCracken.	2.365	3.339	1.880	.121	.289	.078	.282	n. e.	.379	91.147	1.100	1.467	.753	. . . .	Subsoil of next preceding.
2771	McCracken.	3.863	4.089	2.763	.134	.220	.121	.190	.302	.662	88.033	1.655	1.513	.578	. . .	Virgin soil of Red Oak Barrens.
2772	McCracken.	2.335	4.941	2.883	.097	.290	.095	.216	.168	.885	88.309	1.500	1.252	.167	. . . .	Subsoil of next preceding.
2773	McCracken.	2.807	5.336	3.086	.127	.394	.095	.167	.087	.946	87.213	1.500	1.428	.704	. . . .	Virgin soil, Post Oak Flatwoods
2774	McCracken.	2.309	4.982	3.441	.097	.327	.079	.302	n. e.	.761	87.476	1.700	1.435	.718	. . . .	Subsoil of next preceding.
2775	McCracken.	2.083	2.818	1.533	.171	.161	.062	.179	.145	.538	92.726	0.875	1.446	1.062	. . . .	Virgin, fine silty soil.
2776	McCracken.	1.637	3.295	1.950	.161	.235	.030	.125	n. e.	.463	92.642	1.050	1.566	1.219	. . . .	ubsoil of next preceding.
									IN APPENDIX.						Sand and gravel.	
2858	Clinton . .	3.511	6.757		.405	.073	.146	.340	.518	.846	87.366	1.368	.394	n. e.	12.500	Virgin soil, hill-side limestone soil.
2859	Clinton . .	2.998	6.215		.305	.055	.065	.537	.247	.860	88.706	1.625	.497	.214	4.269	Virgin subsoil, hill-side limestone soil.
2860	Clinton . .	2.985	4.243		.151	.145	.097	.351	.317	.514	90.784	.705	.417	n. e.	10.661	Mountain sandy soil.
2861	Clinton . .	2.618	4.361		.051	.109	.064	.247	.256	.453	91.928	.700	.422	n. e.	8.562	Virgin, poor soil.
2862	Clinton . .	5.483	7.335	13.188	trace.	.240	.267	.231	.077	1.285	71.047	2.625	.171	n. e.	11.507	Red under-clay.

TABLE IV.—CLAYS.—(Air Dried.)

Number	County.	Silica	Alumina	Iron peroxide	Lime	Magnesia	Potash	Soda	Water and loss.	Fine sand	Remarks.
2568	Ballard	74.840	16.580	1.400	0.269	0.209	1.293	0.283	5.126	n e.	Sandy, tertiary clay; near Blandville, one-half mile northwest
2569	Ballard	71.180	20.800	1.780	trace.	.101	.247	.291	5.601	n. e.	Clay, 3 miles east of Blandville.
2570	Ballard	76.540	14.820	.960	trace.	.331	.926	.229	6.194	n. e.	Clay, West Fork of Mayfield creek, 4 miles northeast of Millburn.
2571	Ballard	63.840	26.040	.740	trace.	.137	.714	.207	8.322	44.00	Clay, 2 miles north of Wickliffe.
2572	Ballard	44.840	22.830	20.350	.101	.138	n. e.	n e.	11.741	n e.	Yellow ochreous clay, Wickliffe.
2573	Ballard	73.240	15.760	1.920	.325	.519	1.467	.147	6.622	53.490	Fire-clay, Wickliffe.
2638	Calloway	87.300	10.480		.045	.281	.888	.209	.797	n. e.	Decomposed chert, lower carboniferous siliceous group.
2639	Calloway	46.020	38.980		.773	.136	.309	.172	13.610	21.000	Tertiary, northwestern part of Calloway county.
2640	Calloway	61.680	28.500	1.680	.101	.136	1.158	.822	5.923	n. e.	White pipe-clay, below Quaternary gravel.
2641	Calloway	56.680	29.700	1.480	trace.	.281	1.004	.274	10.081	n. e.	Tertiary, black pyritous, plastic clay. (Below 2640.)
2642	Calloway	66.380	16.480	3.500	.213	.497	.928	.228	11.774	39.780	Black joint clay, Lignitic Tertiary.
2643	Calloway	57.840	30.340	1.180	.011	.050	.618	.519	9.442	n. e.	From Russell's pottery, 6 miles east of Murray.
2644	Calloway	54.140	32.140	1.040	.011	.032	.965	.468	11.204	39.000	Dark clay; Mahan's, 6 miles east of Murray.
2645	Calloway	54.400	29.440	1.340	.134	.245	.522	.437	10.482	n e.	Black plastic clay, Tertiary; Rufus Morris'.
2662	Graves	76.780	14.740	1.640	trace.	.389	1.440	.117	4.894	2.400	Decomposing chert, Quaternary.
2663	Graves	62.680	25.880	2.900	trace.	.319	1.147	.928	6.146	n. e.	LaGrange Tertiary, 3 miles north of Lynnville.
2664	Graves	75.120	15.960	1.420	trace.	.317	1.351	.245	5.587	n. e.	Whitish pipe-clay, south of Quill Hill, Tertiary.
2665	Graves	61.920	30.060	.300	trace.	.064	1.602	.239	5.815	n. e.	Boaz Station.
2666	Graves	56.980	32.160	2.160	trace.	.209	.838	.111	7.542	16.440	Clay from Howard's pottery, at Bell City.
2715	Hickman	85.180	10.260	1.120	trace.	.064	.954	.146	2.276	70.100	Fire-clay, bluff above Columbus. Below gravel.
2759	Marshall	84.580	10.650	.330	.137	.101	.954	.292	2.956	70.330	Burradell's, 5 miles north of Benton.
2760	Marshall	52.580	31.070	1.510	.137	.245	1.775	.318	12.365	0	Gray's place, near Scale.
2761	Marshall	91.580	5.980	.220	.045	.055	.094	.032	1.994	33.700	From a cistern on old Winton place.
2762	Marshall	60.980	18.480	7.500	.780	1.128	2.664	.627	7.841	n. e.	Banks of Tennessee river, at Highland.
2763	Marshall	62.920	29.880		trace.	.209	1.564	.172	5.255	n. e.	Pipe-clay, on J. G. Pugh's place.
2764	Marshall	93.700	3.580		trace.	.127	.618	.117	1.858	n. e.	Decomposing chert, 4 miles west of Birmingham.
2777	McCracken	59.500	24.960	.720	.325	.396	1.934	.286	11.879	n. e.	Mr. Jones', 3 miles south of Paducah.
2778	McCracken	66.320	22.930	1.190	.437	.209	1.107	.470	7.337	n. e.	Mr. John Mitchell's, 3 miles east of Lovelaceville.
2779	McCracken	67.580	20.040	.540	1.743	.158	1.340	.075	8.524	small pr.	Gypseous clay; Mr. Hough's place, 4 miles west of Paducah.
2780	McCracken	69.220	17.540	1.440	.437	.858	2.452	.472	7.581	50.580	Blue micaceous clay, on Armstrong's place, 7 miles east of Paducah.
2781	McCracken	73.192	16.540	1.840	.369	.461	1.969	.541	5.088	56.600	Blue micaceous clay, containing Vivianite.

GENERAL REMARKS

APPLYING TO APPENDIX.

(See Page 98 to 135.)

The publication of my Chemical Report, No. 7, N. S., having been delayed, owing to want of funds, the occasion was taken to supplement it, on pages 98 to 135, with the report of the analyses which had been made since Report No. 7 was forwarded to the Director of the Survey.

The Appendix contains the analyses of

71 Coals, mainly from Bell, Harlan and Whitley counties, Kentucky, with seven from West Virginia and two from Claiborne county, Tennessee.
5 Soils from Clinton county, Kentucky.
4 Mineral waters.
3 Iron ores.
9 Cokes (eight from West Virginia, and one from Muhlenberg county, Kentucky).
1 Limestone, believed to be hydraulic.

In all, 93 samples.

The samples of coals from Bell, Harlan and Whitley counties were mostly collected by Mr. R. C. Ballard Thruston, and proved, on analysis, to be, with very few exceptions, very good coals, of the "semi-cannel," "splint," or "block" coals, which compare in composition very favorably with the very best coals in use, and especially are very good coking coals, many of them being better than several coals which are extensively used in other States for the manufacture of good coke.

Some few of these samples were taken from the unopened, much-weathered outcrops of their several beds, and consequently do not represent some of the best qualities of the coal of these beds as it exists deeper in the bank—yielding, for example, a pulverulent coke, when, doubtless, the unweathered coal would give a spongy or cellular coke—and presenting more ash material than belongs to the unaltered coal of the interior of the bed.

For comparison with these Kentucky coking coals, I have appended, in the following table of average compositions, the composition of a Connellsville, Pennsylvania, coal, which is used at a large number of coke ovens, from a recent analysis, reported by Joseph D. Weeks—"MINERAL RESOURCES OF THE UNITED STATES," calendar year 1885, page 99—in the following table of comparison of our Kentucky coals.

Excluding from the list of Bell and Harlan coals given in this Appendix, all samples of cannel coal, and all which left more than 7 per cent. of ash, as being unfit for coking, the result is as follows:

AVERAGE COMPOSITION OF THE COKING COALS OF BELL AND HARLAN COUNTIES.—(Air Dried.)

Percentages of	Fixed carbon.	Volatile matters.	Ash.	Sulphur.
In 19 Bell county coals	60 81	35.35	3 45	0.779
In 19 Harlan county coals	61 00	33.06	3.82	.823
Averages of these 38 Kentucky coals.	60.90	34.20	3.64	.801
Average of Connellsville coal	60.30	31.38	7 24	1.090

No doubt these coals would generally yield coke of very superior quality.

The highest proportions of sulphur in these fifty-two Bell and Harlan county coals was found in Nos. 2879 and 2880 of Harlan, and 2839 of Bell, being severally 1.906, 1.782, and 1.508 per cent.

Of the Bell and Harlan county coals, the compositions of which are given in the first part of Report, probably not more than one-half are good coking coals.

ADDENDA.

Since the preceding report was placed in the hands of the printer the following analyses were made, which, by advice of Mr. Procter, Director of the Survey, are added, as "Addenda."

BELL COUNTY—(Continued.)

No. 2910—COAL. *Kettle Island Branch of Straight creek, Cumberland river, half a mile from the mouth of the creek. Land of Abe Lock.* Geological position: 1st Coal? *Average sample from the 46-inch face.* Collected by A. R. Crandall, July 24, 1888.

A pure-looking, pitch-black coal, breaking, generally, imperfectly cuboidal and irregular, with shining irregular surfaces. Very little fibrous coal or pyrites apparent.

COMPOSITION.—(Air Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	0.20	Total volatile matters	38.60
Volatile combustible matters	38.40		
Much inflated coke	61.40	Fixed carbon in the coke	57.80
		Light brownish-grey ash	3.60
	100.00		100.00
Percentage of sulphur	1.757		

A very good coal, containing rather more volatile combustible matters than the very best coking coal, which would make good coke, which would contain rather more than the best average of sulphur.

No. 2910*a*—COAL, *in the approach to Cumberland Gap*, Bell county. *Geological position:* inter-conglomerate. *Bed varying in thickness from two feet four inches to two feet seven inches.* Collected by *John R. Procter*, August, 1888.

A pure-looking semi-cannel or splint coal.

COMPOSITION.—(Air Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	1.00	Total volatile matters	34.20
Volatile combustible matters	33.20		
Spongy coke	65.80	Fixed carbon in the coke	63.60
		Light reddish-brown ash	2.20
	100.00		100.00

Percentage of sulphur 0.549

A remarkably pure, good coal, which would make very good coke.

Breckinridge County.

No. 2911—Coal *sent by A. Inglis, Breckinridge Cannel Coal Company, Cloverport, Kentucky, August 17, 1888.*

COMPOSITION.—(Air Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	6.30	Total combustible matters	46.80
Volatile combustible matters	40.50		
Dense spongy coke	53.20	Fixed carbon in the coke	47.88
		Light greyish-brown ash	5.32
	100.00		100.00

Percentage of sulphur 2.320

A very good semi-cannel coal. It contains, however, rather large proportion of sulphur.

No. 2912—A, B, C and D. "Bituminous Sandstones." (Sand saturated with petroleum.)

Sample A.—*Ten miles south of Grayson Springs, Grayson county. Base of the conglomerate.* Collected by Edward Orton, August, 1888.

Sample D.—*From same locality.* Collected by Edward Orton. Ten feet thick. Base of the conglomerate.

Sample B.—*From near Elizabethtown, Hardin county. From base of the conglomerate.* Collected by Moritz Fischer.

Sample C.—*From land of John Richards*, Carter county. Tough, pasty, black masses of *sand* penetrated by petroleum, some of which, extracted by gasoline and ether, appeared of the ordinary consistence of rather dense rock oil.

Proportions of petroleum as determined by combustion:

In sample A=9.40 per cent.
In sample B=8.75 per cent.
In sample C=8.50 per cent.
In sample D=8.00 per cent.

CALDWELL COUNTY.

NO. 2913—IRON ORE, *limonite, from "Stone Farm," two and a half miles north of Princeton, Caldwell county.* Geological horizon: *St. Louis. Sample collected by C. C. Genung.*

A hard, generally dark brown, dense limonite, with very little ochreous ore. Only the iron, silica and phosphorus determined, in the air-dried ore, which were as follow:

Percentage of iron, =54.510.
Percentage of silica, = 7.600.
Percentage of phosphorus= .279.

A very good, rich iron ore.

CHRISTIAN COUNTY.

NO. 2914—MINERAL WATER. *From a bored well on the farm of J. S. McCarley, one and a half miles from Hopkinsville, on the L. & N. R. R. Called* "Blue Lick Water" or "*Green Lick.*" *This water was struck at the depth of one hundred feet, and petroleum was found in small quantities in several of the strata passed through.*

The water is said to be "perfectly clear" when first taken out of the well, but it soon becomes turbid, deposits a sediment of a dark color, and of a bituminous character.

It contains 1.07 per cent. of solid matters, mostly saline, with some sulphurous and nitrogenous organic matters; also much hydrogen sulphide gas, with a little carbonic acid gas.

Its saline contents are, namely: Lime and magnesia sulphates; sodium chloride (common salt); lime and magnesia carbonates, and traces of iron and alkaline carbonates.

CRITTENDEN COUNTY.

No. 2915—MINERAL WATER, *from "Crittenden County Sulphur Spring," four miles west of Marion.*

This water contains a notable quantity of hydrogen sulphide gas, with some carbonic acid gas. One thousand grains of the water left only 0.44 of a grain of *saline matters* on evaporation at 212° F.

These consist mainly of sodium chloride and magnesium sulphate, with small traces of iron, lime, potash and lithium salts.

It is a pure but weak "white sulphur" water, which might, no doubt, be advantageously used as a medicinal agent.

JEFFERSON COUNTY.

No. 2916—MINERAL WATER, from depth of 1,900 feet in the well, bored for natural gas, on the property of S. E. Edmunds, on the west side of Third street, between Weissinger and Magnolia streets, Louisville, named "St. Patrick's Well." The water is called "magnetic water."

The well flows two gallons per minute, out of very hard rock, as white as marble. Combustible gas flows out with the water, enough to supply several burners in the structure where the water is dispensed.

Qualitative analysis showed the presence of hydrogen sulphide, a trace of hydrogen carbide, and carbonic acid gases.

It contains, in solution, a considerable proportion of sodium chloride (common salt); also chlorides and sulphates of calcium and magnesium, notable traces of lithium and potassium salts, and some little of acid carbonates of lime and magnesia held in solution by the carbonic acid.

One hundred cubic centimeters of the water, evaporated to dryness at the temperature of 212°, left 1.829 grammes of these saline matters.

As the cork of the jug containing the water had been tampered with and broken in its transit from the well, the gases of the water had mainly escaped before it reached the laboratory.

The magnetic properties of this water, like those of the once celebrated magnetic springs of Michigan, belong to the iron tubing, which is polarized by the earth's magnetism, and not to the water.

KNOX COUNTY.

No. 2917—COAL, *from near Gray's Station, North Jellico Mines*, Knox county. *An average sample from the whole face of the 45-inch bed, taken 65 feet in the entry.* Collected by A. R. Crandall, August 2d, 1888.

A bright, pure-looking, pitch-black, soft coal, breaking large cuboidal and irregular, with irregular, shining surfaces. Very little mineral charcoal or pyrites apparent.

COMPOSITION.—(Air Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	1.20	Total volatile matters	36.60
Volatile combustible matters	35.40		
Spongy coke	63 40	Fixed carbon in the coke	60.00
		Light brownish-grey ash	3.40
	100 00		100.00

Percentage of sulphur 1.043

LAUREL COUNTY.

No. 2918—COAL, *from near Lily. Bed six feet thick. Sample collected by Dr. L. H. Blanton*, April, 1888.

A pure-looking, jet-black coal, imperfectly laminated, breaking, generally, with irregular shining surfaces. Bird's-eye structure in some pieces. A little fibrous coal apparent.

COMPOSITION.—(Air Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	2.40	Total volatile matters	37.90
Volatile combustible matters	35.50		
Spongy coke	62.10	Fixed carbon in the coke	58.30
		Nearly white ash	3.80
	100.00		100.00

Percentage of sulphur 0.961

A remarkably good and pure "semi-cannel" or "splint" coal, which would make very good coke.

LOGAN COUNTY.

No. 2919—MINERAL WATER, *from a "sulphur well," on the premises of the "Logan County Female College,"* Russellville, Kentucky.

On qualitative analysis, this water was found to contain: Carbonic acid gas with a trace of hydrogen sulphide; small quantities of lime and magnesia acid carbonates; traces of potash and soda carbonates, and small proportions of sulphates and chlorides of these bases.

The total amount of saline matters in 100 cubic centimeters of this water, dried at 212° F., was only 0.044 gramme. It is quite a pure, soft, weak sulphur water.

No. 2919*a*—MINERAL WATER, *from a well 163 feet deep, Geo. R. Beall's, near Russellville, Logan county.* Geological position: Lower St. Louis.

By qualitative analysis, it was found to contain hydrogen sulphide and carbonic acid gases.

On evaporation it left of *saline matters*, dried at 212° F., 2.69 parts to the 1000. of the water. These were found to consist of chlorides of sodium, potassium, with a trace of lithium; the sodium chloride (common salt) being in largest proportion; also small proportions of magnesia and lime sulphates and carbonates.

It may be characterized as a weak white sulphur water.

McLEAN COUNTY.

No. 2920—MINERAL WATER, *from well of B. B. Shacklett, Sacramento, McLean county. Collected by Hon. R. S. Triplett.*

Water slightly turbid; very slightly tinted yellowish. Has a somewhat fetid odor in the jug.

One litre of this water, evaporated to dryness at 212° F., left 5.624 grammes of *saline matters*=(0.562 per cent). This was slightly colored with organic matter, and when heated to redness left some charcoal from the organic matter.

Qualitative analysis showed that the saline ingredients were: Magnesia and lime carbonates with a trace of iron; magnesia sulphate (the largest ingredient); lime sulphate, and sodium and potassium chlorides.

The presence of organic matters would very probably render this water unsafe as a common beverage, or for medicinal purposes.

MUHLENBERG COUNTY.

No. 2921—COKE, *made at the Earlington ovens, Hopkins county, from Coal No. 11, not including 11 inches of the top. Pond river, Muhlenberg county. Coal 6 feet 9 inches thick.* Sample collected by R. H. Arkenburgh, Jr. Received May 30, 1888.

No. 2922—COKE, *made at Earlington ovens from Coal No. 9, on Pond river. Coal 5 feet 4 inches thick. Collected by R. H. Arkenburgh, Jr. Received May 30, 1888.*

COMPOSITION OF THESE COKES.—(Air Dried.)

	No. 2921.	No. 2922.
Hygroscopic moisture	0.30	= 0.20 per cent.
Volatile combustible matters	.30	= .30 per cent.
Carbon in the coke	92.60	85.80 per cent.
Ash	6.80	13.70 per cent.
	100.00	100.00 per cent.
Percentage of sulphur	1.896	1.647 per cent.
Color of the ash	light grey-brown.	light grey-brown.

No. 2922 contains more than the usual average of ash material. The other coke is quite pure and good.

OHIO COUNTY.

No. 2923—COAL. *George Bettamy's mine, near South Panther creek, Ohio county. Bed three feet two inches thick.* Sample collected by Moritz Fischer. Received June 27, 1888.

Some portions irregular cuboidal, breaking with shining irregular surfaces; other portions thin lamellated, with thin coatings of mineral charcoal and fine granular pyrites. Some little shining pyrites apparent.

No. 2924—**Coal.** *Justin Simpson's mine, near Ætnaville*, Ohio county, Kentucky. *Bed three feet ten inches thick.* Sample collected by Moritz Fischer.

Resembles the preceding sample.

COMPOSITION OF THESE OHIO COUNTY COALS.

	Air Dried.		Calculated Dried at 212° F.	
	No. 2923.	No. 2924.	No. 2923.	No. 2924.
Hygroscopic moisture . . .	7.60	10.00	. . . . . .	. . . . . .
Volatile combustible matters .	37.80	31.40	40.91	34.89
Coke	54.60	58.60	59.09	65.11
Totals	100.00	100.00	100.00	100.00
Total volatile matters	45.40	41.40	. . . . . .	. . . . . .
Fixed carbon in the coke . .	45.00	53.10	48.70	59.00
Ash	9.60	5.50	10.39	6.11
Totals	100.00	100.00	. . . . . .	. . . . . .
Character of the coke	spongy.	dense spongy	. . . . . .	. . . . . .
Color of the ash	light purplish grey.	nearly white.	. . . . . .	. . . . . .
Percentage of sulphur	2.334	0.934	2.527	1.040

No. 2925—**Iron Ore.** *Land of G. W. Taylor, on west bank of Rough creek, two and a half miles north of Hartford*, Ohio county. Sample collected by John R. Procter, August 26, 1888.

A nodular, dark-blue carbonate ore, superficially oxidated on some parts of the sample. Partially analyzed, the following results were obtained:

AIR DRIED.

Ferric oxide (partly from the ferrous carbonate)	49.360	=34.55 iron.
Alumina	5.713	
Lime carbonate	10.300	
Phosphoric acid	1.867	
Siliceous residue (mostly silica)	14.400	

Magnesia carbonate, carbonic acid, water, etc., were not estimated.

No. 2926—COAL. *Johnson coal, near Fordville, Ohio county. Bed three feet three inches thick. Sample collected by* John R. Procter, August 26, 1888.

Breaks into thin laminæ, which are coated, more or less, with mineral charcoal, with some granular pyrites.

No. 2927—COAL. *J. C. Gentry's, three and a half miles south of Fordsville,* Ohio county. Collected by John R. Procter, August 25, 1888.

Breaks, generally, in thin laminæ, mostly with irregular, shining surfaces; some covered with fine mineral charcoal. No bright pyrites apparent.

COMPOSITION OF THESE OHIO COUNTY COALS.—(Air Dried.)

	No 2926.	No. 2927.
Hygroscopic moisture	6.00	6.10
Volatile combustible matters	35 20	40.30
Coke	58.80	53.60
Totals	100.00	100.00
Total volatile matters	41.20	46.40
Fixed carbon in the coke	45.70	49.50
Ash	13 10	4.10
Totals	100 00	100.00
Percentage of sulphur	1.812	2.115
Character of the coke	dense spongy.	dense spongy.
Color of the ash	nearly white.	light greyish-brown.

No. 2927 is a remarkably good semi-cannel or splint coal, which would make good coke, which, however, would contain a rather larger proportion of sulphur. No. 2926 contains a rather large proportion of ash material.

GEOLOGICAL SURVEY OF KENTUCKY,

JNO. R. PROCTER, Director.

CHEMICAL REPORT

OF THE

COALS, COKES, MINERAL WATERS,

IRON ORES, LIMESTONES, ETC., ETC.,

OF KENTUCKY.

BY ROBERT PETER, M. D., ETC.,

CHEMIST TO THE SURVEY.

THE EIGHTH CHEMICAL REPORT IN THE NEW SERIES, AND THE ELEVENTH SINCE
THE BEGINNING OF THE SURVEY.

STEREOTYPED FOR THE SURVEY BY E. POLK JOHNSON, PUBLIC PRINTER, FRANKFORT.

INTRODUCTORY LETTER.

CHEMICAL LABORATORY,
KENTUCKY GEOLOGICAL SURVEY,
LEXINGTON, KY., January 22d, 1890.

JOHN R. PROCTER,

Director of Geological Survey of Kentucky:

With pleasure I herewith transmit to you, for publication, my report of the chemical work done in this laboratory since my last report.

Very respectfully,

ROBERT PETER, M. D., ETC.,
Chemist to the Kentucky Geological Survey.

CHEMICAL REPORT.

Of the 82 samples of Coals submitted to analysis, 9 were from Bell county; 9 from Jackson county; 6 from Laurel county; 9 from Lawrence county; 1 each from Martin and Owsley counties; 22 from Pike county; 7 from Pulaski county; 3 from Rockcastle county; 12 from Whitley county, and 3 from Tennessee.

The Pike county coals analyzed showed the greatest number with the *smallest average* proportions of *volatile combustible matters*; which ranged from 26.00 per cent. in No. 2999, up to 28.13 per cent. in No. 2994.

The *highest* proportions of volatile combustible matters in the *cannel coals*, range from 40.50 per cent. in No. 2969, of Lawrence county, up to 52.34 per cent. in No. 2928, of Bell county, and 54.80 per cent. in No. 2983 of Owsley county. The lowest proportion is 24.70 per cent. in No. 2962 from Laurel county.

The proportions of *carbon in the cokes*, from 26.66 per cent. in No. 2928, Bell county (a cannel coal with 20.40 per cent. of ash), range up to 60.00 per cent. in No. 2989, and as high as 65.80 per cent. in No. 3000; both Pike county coals.

Of the 22 samples of coal from Pike county analyzed, no less than ten contained fixed *carbon in the coke*, in proportions varying from 60.00 per cent. in No. 2987, up to 65.70 per cent. in No. 3002.

The highest percentages of carbon in the coke of the Bell county coals were 62.50, 62.80 and 63.60; in numbers, 2936, 2934 and 2935, severally.

The *ash* percentages range from 1.40 per cent, in No. 2934 of Bell county, and as low as 0.90 per cent in No. 2954, of Laurel county, up to 10.00 in No. 2970, of Lawrence county, and as high as 37.54 per cent. in No. 2962, of Laurel county.

There being eleven of the coals examined, several of which are cannel coals, the ash percentages range between 10.00 and 37.54 per cent. The remainder of the 82 coals analyzed, gave ash percentages ranging from 0.90 to 9.40 per cent.; 34 of the 82 having ash percentages, ranging from 0.90 to 6.00 per cent. only.

The percentages of *sulphur* range from 0.370 per cent., in No. 2928, of Bell county, up to as high as 6.450 and 4.714, in Nos. 2967 and 2960, of Lawrence county, and 4.670 per cent. in No. 2962, of Laurel county. These, however, are exceptional cases; in the whole 82 coals the sulphur percentages are in smaller proportions than 1 per cent.; ranging from 0.370 per cent. upward.

In regard to the coking quality of these coals, it is probable that samples Nos. 2931, 2932, 2933, 2934 and 2935, of *Bell county*, would make good coke. Their *ash* percentages being, severally, 6.40, 6.40, 5.70, 1.40, and 2.40. Of course, those which leave the smallest proportion of *ash* are the best.

Of the Jackson county coals, only Nos. 2949, 2954, 2955 and 2956, would, most probably, make good coke; containing, severally, 6.40, 8.20, 6.30, 3.10 and 4.64 per cent. of ash. An ash percentage in the coal of 8.20 would probably be too high for coke of *best* quality. The larger ash percentages in the other samples which gave "spongy coke," diminish proportionally their value as fuel.

The 6 Laurel county coals give three which may yield good cokes, viz: Nos. 2959, 2960 and 2961, the ash percentages of which are severally 0.90, 2.90 and 5.80. No. 2963 is a coking coal, but it leaves 7.60 per cent. of ash, which, of course, would make a larger percentage in the coke.

Of the 9 coals from Lawrence county, only three would probably make coke of the first quality, viz: Nos. 2965, 2971 (bis) and 2967, which give, severally, 4.20, 4.40 and 6.00 per cent. of ash. The other coking coals of this county reported, viz: Nos. 2964, 2966, 2969 and 2968, are reduced in value by their larger proportions of ash, severally amounting to 8.20, 14.00, 14.20 and 16.00 per cent.

Seven of the Pike county coals analyzed promise to yield good cokes, viz: Nos. 2986, 2988, 2989, 2991, 2992 2995 and

2998; the ash percentages of which coals are, severally, 6.40, 6.40, 6.00, 5.40, 6.20, 5.80 and 4.60.

The cokes of the other coking coals of this county, reported above, are diminished in value by their larger proportions of ash, and the large percentages of *sulphur* in coals Nos. 2986, 2991, and 2992, amounting to 1.703, 2.527 and 2.280 per cent., severally, might diminish the value, for some uses, of the cokes made from them.

The seven Pulaski county coals gave only three which promise good cokes, viz: Nos. 3009, 3012 and 3013, which leave severally 8.00, 9.40 and 5.60 percentages of ash. Only one of these, viz: No. 3013 would give coke of the best quality, the large ash of the other two diminishing their value.

The three Rockcastle samples promise only one which would give good coke, viz: No. 3018, the ash of which coal is only 4.40 per cent., and the sulphur only 0.494 per cent.

Among the twelve Whitley county coals analyzed, eight promise to give good cokes, viz; Nos. 3022, 3023, 3024, 3026, 3027, 3028, 3031 and 3032, which, severally, left only 3.70, 1.40, 1.30, 2.80, 3.40, 4.00, 4.80 and 5.14 per cents. of ashes. The percentages of *sulphur* in these coals being, severally, 0.453, 0.494, 0.714, 0.796, 0.961, 0.522, 1.428 and 0.659.

Whitley county appears to be especially favored in coking coals.

BELL COUNTY.

COALS.

No. 2928—CANNEL COAL, from a mine opposite Pineville, belonging to the "Four-mile Coal and Land Company."

A dull-black, exceedingly tough cannel coal or bituminous shale, imperfectly laminated, in some parts breaking with imperfect conchoidal fracture. No pyrites or fibrous coal apparent. Sample sent from Frankfort February 23, 1889.

No. 2929—COAL: on Caney Fork of Left Fork of Straight creek. A 42-inch coal without parting. Average sample collected by R. C. B. Thruston, August 20, 1888.

No. 2930—COAL: on right-hand Fork of Straight creek, two-and-a-half miles above the mouth. Geological position, upper splint bed. Bed 60 inches thick. Average sample taken from the entire bed, except a 6-inch parting, by R. C. B. Thruston, August 20, 1888.

No. 2931—COAL: average sample from the 48-inch coal in the bed of Straight creek, dipping 70 degrees, near the mouth of "Kettle Island Branch." Collected by R. C. B. Thruston, August 22, 1888.

No. 2932—COAL: "Cockerell's coal," on Cannon creek, one mile above the railroad. Average sample of the 2 feet 8 inches face of the bed. "Lower Barner Seam." Collected by A. R. Crandall, May 26, 1889.

No. 2933—COAL: "Cockerell's coal, Barner seam," on Cannon creek. Average sample from the 2 feet 10 inches face of the bed. Collected by A. R. Crandall, May, 1889.

No. 2934—COAL: "Cockerell's coal," on Cannon creek. Average sample from the 37-inch face of the bed under the sandstone ledge, 500 feet above the creek. Collected by A. R. Crandall, May 31, 1889.

No. 2935—COAL on Bennett's Fork, in Fork Ridge. Average sample of the 48-inch face, driven in 75 yards. Collected by A. R. Crandall, December 17, 1889.

No. 2936—COAL on "Bennett's Fork," near Tennessee line, Mingo mountain. Average sample of the bed. Coal 64 inches, clay-parting 6 inches. Collected by A. R. Crandall, December 17, 1889.

COMPOSITION OF THE ABOVE DESCRIBED BELL COUNTY COALS.—(Air Dried.)

Number in Report.	2928	2929	2930	2931	2932	2933	2934	2935	2936
Hygroscopic moisture	0.60	1.20	2.20	2.06	1.00	1.20	2.00	1.20	3.46
Volatile combustible matters	52.34	33.80	34.70	35.54	36.50	36.30	33.80	32.80	30.24
Coke	47.06	65.00	63.10	62.40	62.50	62.50	64.20	66.00	66.30
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	52.94	35.00	36.90	37.60	37.50	37.50	35.80	34.00	33.70
Carbon in the coke	26.66	61.80	58.36	56.00	56.10	56.80	62.80	63.60	62.50
Ash	20.40	3.20	4.74	6.40	6.40	5.70	1.40	2.40	3.80
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Percentage of sulphur	0.370	0.549	1.126	3.845	2.193	2.335	0.577	0.489	0.755
Character of the Coke	pulverulent.	spongy.	Dense friable.	light spongy.	spongy.	spongy.	spongy.	light spongy.	friable.
Color of the ash	grey-brown.	light brown.	reddish brown.	dark lilac.	purplish grey.	purplish grey.	light brown'h.	light reddish.	light reddish.

These Bell county coals are all valuable; even the cannel coal, No. 2928, with its small proportion of carbon in its pulverulent coke—only 26.66 per cent.—and its large quantity of ash—20.40 per cent.—may be profitably used in the production of gas, or as fuel, because of its large proportion of volatile combustible matters, which equal 52.34 per cent. of its weight, and which, besides giving out more light in burning, gives very much more heat than an equal weight of fixed carbon. Its proportion of sulphur, also, is quite small.

The coals, numbers 2029, 2931, 2932, 2933, 2934 and 2935, all appear to be coking coals. The best and most valuable of these are Nos. 2929, 2934 and 2935, which yield, severally, 61.80, 62.80 and 63.60 per cent. of fixed carbon (stated in the order in which they are named), contained in 65.00, 64.20 and 66.00 per cent. of spongy cokes, and contain only 0.549, 0.577 and 0.439 per cent., severally, of sulphur.

The other coking coals described above, viz: numbers 2931, 2932 and 2933, containing, severally, 3.845, 2.193 and 2.335 per cent. of sulphur, would be less valuable, especially in the iron industry, than the others mentioned above, but yet would be very good fuel for most purposes; all leaving but a moderate proportion of ash in burning.

No. 2934 leaves but a remarkably small proportion of ash on burning, viz: only 1.40 per cent. The ashes of all these coals, except that of the cannel coal, are below the general average from good coals, varying from 1.40 per cent. in No. 2934, to 6. 40 per cent. in Nos. 2931 and 2932. The coals, Nos. 2930 and 2936, which yielded only *friable cokes* in the crucible, are quite pure and valuable coals for all ordinary purposes, and may, possibly, under the pressure of the coking-oven, yield good coke.

BELL COUNTY COKE.

No. 2937—COKE. Seventy-two-hour coke, made from the run of the mine.

Sample from Pine Mountain Iron Company, Pineville, Bell county. Received April 24, 1889.

COMPOSITION.

Hygroscopic moisture	0.40	Volatile matters	0.70
Volatile matters at red heat	.30		
Coke	99.30	Carbon in the coke	94.90
		Grey-brown ash	4.40
	100.00		100 00
Percentages of sulphur	0.492		

Quite a good, pure coke.

BELL COUNTY IRON ORES.

No. 2938—**ORISKANY IRON ORE**, on Straight creek. Average sample from the 6½ feet exposure. Collected by R. C. B. Thruston, August 23, 1888.

A cellular limonite, with much ochreous incrustation.

No. 2939—"**LOOK'S IRON ORE.**" Kettle Island Branch of Straight creek. Bed 3 feet 7½ inches thick. Average sample from the whole face of the bed collected by R. C. B. Thruston, August 22, 1888.

A limonite ore encrusted with ochreous material; some lumps with a little iron carbonate in the interior.

COMPOSITION OF THESE BELL COUNTY IRON ORES.—(Air-Dried.)

Numbers.	2938	2939
Iron peroxide	a 60.023	c 71.120
Alumina	5 148	3.680
Lime carbonate	trace.	1.900
Magnesia	.180	2.160
Phosphoric acid	b .639	d 3.110
Sulphur	.412	1.098
Silica	19.500	16.932
Water, etc., and loss	14.098	
	100.00	. . . . .

(a.) Equal to 42.164 per cent. of iron.

(c.) Equal to 49.784 per cent. of iron.

(b.) Equal to 0.279 per cent. phosphorus.

(d.) Equal to 1.340 per cent. phosphorus.

Rich iron ores—large phosphorus in No. 2939.

BRECKINRIDGE COUNTY.

No. 2940—"BITUMINOUS SANDSTONE." Breaks of Rough river, Lost Run, 6 miles east of Hardinsburg. Bed 5 to 7 feet thick. Sample collected by Mr. J. C. Fawcett, January, 1889.

No. 2941—"BITUMINOUS SANDSTONE," collected by Mr. C. W. Moorman, of Cloverport, who states that it is 3 to 30 feet in thickness, says he has 700 acres of it. The sample is from its outcrop. Analyzed by incineration, etc.

COMPOSITION OF THESE BITUMINOUS SANDSTONES.—(Air Dried.)

Number.	2940	2941
Semifluid bitumen (or Petroleum)	7.96	9.25
Fine siliceous sand	91.04	90.75
Water	1.00	.....
	Petroleum.	Fine sand.
See Carter county for analysis of another bituminous sand, the composition of which is	3.56	96.44
Another from Fort Duchene, Utah	6.37	90.44

It appears, on analysis, that what seems to be a compact, and, sometimes, a tough *sandstone* resolves itself, on analysis, by burning, or by the action of bitumen solvents, into petroleum and fine sand, which, in some samples, is beautifully pure and white. Whether thick petroleum could be used with advantage on macadamized or sandy streets and roads, is well worthy of trial; it would, at least, prevent the penetration of water, which is so very injurious. If the experiment is made, the street or road should be perfectly dry and the petroleum should be heated.

CALDWELL COUNTY.

No. 2942—MARL. Somewhat indurated. From land of Mr. E M. Stephens, 3 miles east of Princeton, Caldwell county, Ky. Bed 4 feet thick.

Mostly in soft, friable laminæ, of a light-grey color, nearly white, with some ferruginous stains. Quite plastic with water when pulverized. Fused before the blow-pipe. Did not prove to be "hydraulic" on experiment.

COMPOSITION OF THIS MARL.—(Air Dried.)

	Per cent.
Silica	37.800
Alumina, with trace of iron oxide	13.321
Lime	21.168
Magnesia	1.440
Phosphoric acid	1.279
Potash	2.391
Soda	2.234
Water, carbonic acid and loss	20.867
	100.000

The potash, phosphoric acid, lime, etc., contained in this marl, may recommend it as a top-dressing to a poor soil. It might probably be also used in some forms of *terra cotta* or cheap pottery.

CARTER COUNTY.

No. 2943—BITUMINOUS SAND, from head of Tygert's creek. A tough, black solid, which, when rubbed up in a mortar, became soft and somewhat plastic. Digested in gasoline, etc., it gave up, of thick petroleum, 3.56 per cent., leaving pure white sand, 96.44 per cent.

The sand appeared to be pure enough to be employed in the manufacture of the finest white glass.

DAVIESS COUNTY.

No. 2944—"CANNEL SHALE," from Owensboro, Daviess county, sent by R. S. Bevier to Mr. Procter, October 1, 1888.

A dense black shale, with impressions of small bivalve shells and some bright pyrites.

COMPOSITION.—(Air Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	2.70	Total volatile matters	14·50
Volatile combustible matters	11.80		
Pulverulent residue	85.50	Carbon in the residue	13.10
		Grey-brown residue	72.40
	100.00		100.00

Of very little value for fuel.

No. 2945—Mineral Water from Bell's farm, 12 miles south of Owensboro, on the line of the Owensboro and Falls of Rough Creek Railroad. Sample collected by Captain R. S. Triplett. Received July 15, 1889.

The water gave a slightly acid reaction, and had deposited a small amount of ferruginous sediment in the jug in which it was brought.

COMPOSITION IN 1,000 PARTS.

Iron sulphate	0.031
Alumina Sulphate	.928
Lime sulphate	.507
Potash sulphate	.024
Soda sulphate	.019
Sodium chloride	.019
Magnesium chloride	.057
Silica	.028
Total saline matters in 1,000 parts of the water	1.613

The principal active ingredients of this water are the sulphates of alumina and lime. It is slightly chalybeate and astringent

Fayette County.

The great durable fertility of the region of the limestone of of the Lower Silurian formation, in which Fayette and its neighboring counties are located, is owing greatly to the phosphoric acid and other fertilizing materials which exist in notable proportions in this limestone. As early as 1848, the attention of the present writer was attracted to this subject, and, in the Albany *Cultivator* of April, 1849, he published the result of two analyses of this limestone taken from a well in Lexington, with remarks on the great value of this ready source of these essential elements of fertility.

At that time, however, the methods of chemical analysis were by no means perfect, and the proportion of phosphoric acid in the limestone analyzed was, no doubt, greatly underrated at 1.35 per cent. In more recent times, many more analyses have been made by him of different layers of our limestone from different localities in Fayette county, and it has been found that, while this whole limestone formation contains phosphoric acid, it varies in proportion from about 1.40 per cent. up to more than 31. per cent. ; and that the richer layers of the rock have, nowhere been found, as yet, of more than one foot in thickness, as is the case with the remarkable layer on the Newtown turnpike, described in Chemical Analyses of Kentucky Geological Survey, Vol. A., page 245.

The results of a few more analyses of the blue limestone of Fayette county, for the determination of the phosphoric acid, are given below :

No. 2946—B. BLUE LIMESTONE. Structure fine crystalline, granular; used on the turnpike, just beyond Lexington, on the Newtown road, opposite the brick-yard.

Proportion of *phosphoric acid* found, 7.935 per cent.

No. 2946—C. Blue limestone, on the same road, from farm of Mr. Cromwell, about 3 miles from Lexington.

Proportion of *phosphoric acid* found, 2.982 per cent.

No. 2946—D. Fossiliferous blue limestone, the softer, marly layer found between the harder layers. Winton farm, 7 miles from Lexington, on the same road.

Proportion of phosphoric acid, only 3.136 per cent.

An analysis of another thin layer on the side of South Limestone street, Lexington, near the Agricultural Experiment Station, made in the laboratory of the station, gave proportion of phosphoric acid, 29.73 per cent.

In the several thin layers found in this limestone on South Limestone street, examined at the Agricultural Station, the phosphoric acid was found to vary from 29.73 (d) per cent., as above stated, equal to 64.93 per cent. of phosphate of lime, down to 3.84 per cent., equal to 8.83 per cent. of phosphate of lime. A layer in the limestone at the city quarry was found to yield only 3.30 per cent. of phosphoric acid, equal to 7.21 per cent. of phosphate of lime.

The great body of the limestone, no doubt, contains a still smaller percentage.

Floyd County.

No. 2947—Limonite Iron Ore, from Cane Branch of Beaver creek, on farm of Jefferson Robinson, Floyd county. Sample collected by C. N. Brown, September 5, 1888.

A reddish-brown limonite.

COMPOSITION.—(Air Dried.)

	Per cent.	
Iron peroxide	55.526	Equal 38.868 per cent. of iron.
Alumina	10.568	
Lime carbonate	12.100	
Magnesia carbonate	2.497	
Phosphoric acid	2.046	Equal 0.893 per cent. of phosphorus.
Silica	5.000	
Water and loss	12.263	
	100.000	

Jackson County.

No. 2948—"Cannel Coal," on Deer Fork of Horse Lick creek, Jackson county. Bed 33 inches thick, at the top of the conglomerate rock. Average sample from the whole face of the bed near the outcrop. Some little clay adhering to the sample. Collected by A. R. Crandall, June, 1889.

A dull-looking cannel coal.

No. 2949—Coal. "Jack Carpenter's coal," Horse Lick creek Jackson county, near the top of the conglomerate limestone. Average sample of the 36-inch face, near the outcrop. Collected by A. R. Crandall and Sullivan, June 25, 1889.

No. 2950—Coal. Wells'. Sand Lick creek, Jackson county. Average sample from the whole 36-inch face, without parting, near the outcrop. Collected by G. M. Sullivan, June 28, 1889.

No. 2951—Coal, on Mace Branch of Big Clover creek, Jackson County, 45 feet above the Subcarboniferous limestone. Average sample from the upper and lower benches. Collected by G. M. Sullivan, June 28, 1889.

Upper bench, 2 feet 7 inches; clay parting, 9¾ inches; lower bench, 2 feet 4 inches.

No. 2952—COAL. Pete McDaniel's, on Joe's Branch of Raccoon creek, Jackson county. Average sample from the 3 feet face at the outcrop. Collected by A. R. Crandall, June 28, 1889.

No. 2953—COAL of Jake Gabbard's bank, Indian creek, 3 miles below McKee, Jackson county. *Geological position* 95 feet above the Subcarboniferous limestone. Average sample. Collected by G. M. Sullivan, July 8, 1889

No. 2954—COAL on Scott Dickson's land, Bell's Branch of Indian creek, 1½ miles from McKee, Jackson county. *Geological position* 120 feet above the Subcarboniferous limestone. Average sample. Collected by G. M. Sullivan, August 14, 1889. Bed 36½ inches.

No. 2955—COAL from "Turkey-foot Bank," owned by Captain Wilson, Turkey-foot Branch of War Fork of Station Camp, Jackson county. *Geological position* 85 feet above the Subcarboniferous limestone. Average sample. Collected by G. M. Sullivan, August 15, 1889.

No. 2856—COAL from the "Shelton Brock" bed, near Collinsworth; 30 inches thick; on Rock Lick Branch, a tributary of Big Clover creek. Average sample. Collected by G. M. Sullivan, October 18, 1889.

COMPOSITION OF THESE JACKSON COUNTY COALS.—(Air Dried.)

Number in the Report.	2948	2949	2950	2951	2952	2953	2954	2955	2956
Hygroscopic moisture	1.80	3.60	3.20	3.20	1.70	4.60	3.40	4.40	1.70
Volatile combustible matters	42.40	33.20	32.80	32.10	37.60	27.30	32 60	36.60	35.10
Coke	55.80	63.20	64.00	64.70	60 70	68 10	64 00	59 00	63.20
Totals	100.00	100.00	100.00	100.00	100 00	100.00	100.00	100 00	100.00
Total volatile matters	44.20	36.80	36.00	35.30	39.30	31.90	36.00	41.00	36.80
Carbon in the coke	46.60	56.80	55.80	51.70	49.10	58.10	57.70	55.90	58.56
Ash	9 20	6.40	8.20	13.00	11 60	10.00	6.30	3.10	4.64
Totals	100.00	100.00	100.00	100 00	100.00	100.00	100 00	100.00	100.00
Character of the coke	dense spongy.	spongy.	spongy.	dense spongy.	spongy.	dense friable.	dense spongy.	light spongy.	spongy.
Color of the ash	very lt.-grey.	lt.bro'sh-grey.	grey.	dark-grey.	grey-brown.	light grey.	purpl'h-brown.	lt.bro'sh-grey.	brown'h grey.
Percentage of sulphur	0.645	0 494	0.782	0.480	2.307	0.522	1.648	1.098	0.824

The only coal entitled to the name of *cannel* coal, among these samples, is No. 2948, which gave 42.40 per cent. of volatile combustible matters; the other samples yielding only from 27.30 per cent. in No. 2953, up to 36.60, No. 2955. This coal, No. 2948, leaving only 9.20 per cent. of ash, and a dense spongy coke, is purer than most other cannel coals.

No. 2955 gave only 3.10 per cent of ash, the lowest of all the samples; the proportions running up to 10.00, 11.60 and 13.00, in Nos. 2953, 2952 and 2951. All except Nos. 2948, 2951, 2952 and 2953, would make very good coke; those named, as well as No. 2949, containing an objectionable large quantity of ash.

JEFFERSON COUNTY.

No. 2957 (2) **LIMESTONE** from a bed in the canal at Louisville. Sample sent by Wm. Skeene & Co., July, 1889.

COMPOSITION, as received in powdered condition in a barrel.

Lime carbonate	77.290
Magnesia carbonate	7.870
Lime sulphate	.992
Phosphoric acid	.383
Alumina and iron oxide	.330
Potash and soda	tr. only.
Silicious residue	4.900
Moisture and loss	8.235
	100.000

Quite a pure, somewhat magnesian limestone, which would make very pure white lime on calcination, but would hardly pay as a fertilizer, except on soils very deficient of lime.

JOHNSON COUNTY.

COKE.

No. 2957 (3). **COKE**, from coal of Greasy creek. Sample sent by J. H. Northrop, August 9, 1889.

COMPOSITION.

Hygroscopic moisture	3.60	Total volatile matters	4.40
Volatile combustible matters	.80		
Coke	95.60	Carbon in the coke	88.60
		Grey ash	7.00
	100.00		100.00

Percentage of sulphur 0.576

LAUREL COUNTY.

No. 2958—"SEMI-CANNEL COAL," from a 36-inch seam, located 1½ miles from Lily Station on the Louisville & Nashville railroad, Laurel county. The seam is 5 feet below water level. An average sample of the whole bed. Sent July 17, 1889.

Rather a dull-black, semi-cannel coal, breaking in laminæ, with some mineral carbon between, but no apparent pyrites; some little ferruginous incrustations on external surfaces.

No. 2959—COAL; from mine at Lily, on the Knoxville Branch of the L. & N. R. R., owned and worked by the Lily Mining & Manufacturing Company. Total thickness of the bed 44 inches. Sample sent by Rev. L. H. Blanton.

A bright, pure-looking coal, presenting, in some parts, "bird's-eye" structure; no mineral carbon apparent, but a little bright pyrites.

No. 2960—COAL; From Lily, Laurel county. Average sample from two rooms of the 44-inch face of the bed, including a 2-inch "bone-coal," 8 inches from the top. Collected by A. R. Crandall, June 6, 1889.

No. 2961—COAL; at "Winding-stair Gap," Laurel county. Average sample from the 38-inch face, driven in about 10 feet. Collected by A. R. Crandall, July 31, 1889.

No. 2962—COAL; on "Indian Camp Branch," a tributary of Craig creek, 2 miles above Vox Post-office, Laurel county, on John Brewer's land; known as "Brewer's cannel coal," 32 inches thick. Average sample collected by G. M. Sullivan, October 8, 1889.

No. 2963—COAL; 52 inches thick, on W. F. Bray's land, known as Bray's coal-bank, on Craig creek, near Vox Post-office, Laurel county. Average sample collected by G. M. Sullivan, October 7, 1889.

No. 2963 (bis)—CARBONATE IRON ORE; from Laurel river, near Lily. Sample by A. R. Crandall, June, 1889.

Found, by titration to contain 32.766 per cent. of iron in its 86.919 per cent. of carbonate, etc.

COMPOSITION OF THESE LAUREL COUNTY COALS.—(Air-dried.)

Number in Report.	2958	2959	2960	2961	2962	2963
Hygroscopic moisture	1.20	1.80	2.00	1.80	1.30	1.70
Volatile combustible matters	38.00	37.60	37.00	36.40	24.70	33.50
Coke	60.80	60.60	61.00	61.80	74.00	64.80
Totals	100.00	100.00	100.00	100,00	100.00	100 00
Total volatile matters	39.20	39.40	39.00	38.20	26.00	35.20
Carbon in the coke	46.60	59.70	58.10	56.00	36.46	57.20
Ash	14.20	0.90	2.90	58.00	37.54	7.60
Totals	100.00	100.00	100.00	100.00	100.00	100.00
Character of the coke	dense spongy.	dense spongy.	light spongy.	light spongy.	pulverulent.	spongy.
Color of the ash	lilac-grey.	white.	grey.	light purplish-grey.	grey-brown.	brownish grey.
Percentage of sulphur	0.797	0.810	1.035	1 650	4.670	1.785

Of these coals, it is probable the following may be used in the manufacture of coke, named in the order of their relative value for this use, viz: Nos. 2959, 2960, 2961 and 2963. The best of them is No. 2959, which gave 60.60 per cent. of dense spongy coke, containing 59.70 of carbon, and a very remarkably small proportion of white ash, viz: only 0.90 per cent. Nos. 2960, 2961 and 2963 containing rather more ash and sulphur, would, no doubt, yield good coke for all ordinary purposes. Nos. 2958 and 2962—containing, severally, 14.20 and 37.54 per cent. of ash material—while they may be used as ordinary fuel are, of course, proportionately less valuable than the purer coals.

LAWRENCE COUNTY.

COALS.

No. 2964—COAL; head of Straight Fork of Donathan creek. Average sample from the middle 15 inches. Collected by A. R. Crandall, August 27, 1888.

Irregularly laminated; some mineral charcoal on the laminæ, with a little of fine-grained pyrites.

No. 2965—COAL from the same bed as the next preceding sample. Average sample by Mr. Crandall, from the upper 27 inches.

Resembles the preceding sample; somewhat more laminated.

No. 2966—COAL from the same bed as preceding. Average sample of the lower 17 inches. By Mr. Crandall.

Resembles the two preceding samples, except that some portions break into thin lamellæ, resembling bituminous shale.

No. 2967—COAL; a lump from the bottom 6 inches. Collected by A. R. Crandall, August 27, 1888.

Fracture generally irregular, with irregular, shining surfaces; some portions laminated, with dull surfaces coated with mineral charcoal and fine grained pyrites.

No. 2968—COAL; on Jacob Peters' land, on Three-mile creek, Lawrence county. Average sample from the top 37 inches. Collected by A. R. Crandall, August 27, 1888.

No. 2969—COAL; average sample from the bottom 13 inches of the bed next above described.

No. 2970—COAL; "Big Coal," on Griffith's creek, Lawrence county. Sample collected by John R. Procter, August 29, 1888.

A lump with ferruginous coating on one edge. Breaks into irregular laminæ, which are coated irregularly with fibrous coal and fine granular pyrites.

No. 2971—"CANNEL COAL" (White House). Mouth of White House, Lawrence county. Average sample from the whole bed, from 2 pits 200 feet in. Collected by A. R. Crandall.

A pure-looking cannel coal; no fibrous coal or pyrites apparent. Fracture imperfectly conchoidal.

COMPOSITION OF THESE LAWRENCE COUNTY COALS.—(Air-dried.)

Number in Report.	2964	2965	2966	2967	2968	2969	2970	2971
Hygroscopic moisture	3.00	6.00	3.00	3.00	2.20	1.80	4.00	1.20
Volatile combustible matters	36.40	32.40	36.00	39.00	33.80	40.50	39.40	41.80
Coke	60.60	61.60	61.00	58.00	64.00	57.70	56.60	57.00
Totals	100.00	100.00	100.00	100.00	100 00	100.00	100.00	100.00
Total volatile matters	39.40	38.40	39.00	42.00	36.00	42 30	43.40	43.00
Carbon in the coke	52.40	57.40	47.00	52.00	48.00	43.50	46.60	46.00
Ash	8.20	4.20	14.00	6.00	16.00	14 20	10.00	11.00
Totals	100.00	100.00	100 00	100.00	100.00	100.00	100.00	100.00
Character of the coke	dense spongy.	dense spongy.	spongy.	light spongy.	light spongy.	spongy.	dense spongy.	friable.
Color of the ash	reddish grey.	reddish grey.	purplish grey.	purplish grey.	dk. pur'h grey.	dk. pur'h grey.	lt. pur'h grey.	brownish grey.
Percentage of sulphur	0.961	0.494	4.714	6.450	1.922	1.378	0.988	0.961

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* See end of Lawrence county for analysis of another coal.

Remarkable differences are shown in the composition of the four samples of different layers in the same bed of coal; Nos. 2964-5-6-7—for example; the *Hygroscopic moisture* was found to be as high as 6 per cent. in the coal of the upper layer, No. 2965, and only 3. per cent in the 3 other layers. The *volatile combustible matters*, 32.40 per cent. in this upper layer, was 39. per cent. in the bottom 6 inches, No. 2967. The *coke*, 58 per cent. in this bottom layer, was 61.60 per cent in the upper 27 inches, No. 2965.

The carbon in the coke, 57.40 per cent. in the upper 27 inches, was only 47. per cent. in the lower 17 inches, No. 2966.

The proportions of *ash* in these different layers of the bed varied still more, being only 4.20 per cent. in the upper 17 inches (No. 2965), and as high as 14.00 per cent. in the lower 17 inches (No. 2966).

Sulphur was found in the proportions of 0.494 per cent. in the upper 27 inches in No. 2965, and as high as 4.714 and 6.450 in Nos. 2966 and 2967, the lower layers.

The coals of each layer examined yielded a spongy coke in the crucible. The largest ash proportions are in Nos. 2970, 2971, 2966, 2969 and 2968, which gave from 10. to 16. per cent. of ash on burning. While their cokes might be available for many purposes, they could not compete in the iron industry with cokes which contained less earthy material; more especially as these cokes contain also large proportions of sulphur.

For ordinary fuel, of course, these coals are all available, but their real value is always to be discounted by the quantity of ashes they leave behind in burning.*

LAWRENCE COUNTY.

IRON ORES.

No. 2972—LIMONITE IRON ORE, from a bed at See Gap. A dense, dark-brown ore, coated and mixed with ochreous ore. Collected by A. R. Crandall.

No. 2973—IRON ORE; *Yellow Kidney*, on Straight creek, fork of Three-mile creek, Lawrence county. Sample collected by A. R. Crandall, August 27, 1888.

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* See end of the following iron ores for another Lawrence county coal.

No. 2974—**Iron Ore**; *Limonite*, irregularly cellular, with a little ochreous ore. Head of Three-mile creek, Lawrence county. Collected by A. R. Crandall, August 28, 1888.

No. 2975—**Iron Ore**; *Limonite*, from same locality as the next preceding; similar ore. Collected by A. R. Crandall.

No. 2976—**Iron Ore**; part of a nodule of dense Limonite, with soft ochreous material in the interior. Wallbridge's Station, on Chattaroi Railroad, Lawrence county.

No. 2977—**Iron Ore**; *brown Limonite ore.* Peck's Station, Griffith's creek, Lawrence county. Collected by A. R. Crandall, August 28, 1888.

No. 2978—**Iron Ore**; head of Griffith's creek. A dense, dark-reddish-brown Limonite ore. Collected by A. R. Crandall, August 27, 1888.

No. 2979—**Iron Ore**; north of Louisa, Lawrence county. Said to be three feet thick. Sample sent from Frankfort by Mr. Procter, received September 7, 1888.

A very hard oolitic ore.

COMPOSITION OF THESE LAWRENCE COUNTY IRON ORES.—(Air-Dried.)

Number in Report.	2972	2973	2974	2975	2976	2977	2978	2979
Iron peroxide	45.476	52.469	54 185	63.313	57.029	64.329	54.506	60.786
Alumina	9 525	9.732	17.423	9.444	5.999	6.786	15.151	7.771
Lime carbonate	trace.	trace,	trace.	trace.	trace.	trace.	14.800	.600
Magnesia carbonate	.378	trace.	.454	.076	.156	.151	2.052	.681
Phosphoric acid	.639	.639	.512	.383	.512	3.325	383	.383
Silicious residue	34.000	23.300	16.000	12.400	25.400	9.400	3.800	13.600
Water and loss	9.982	13.860	11.426	14.384	10.904	16.009	9.308	16.179
Totals	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
Percentage of iron	31.832	36.735	37.930	44.319	39.920	45.030	38 154	42.550
Percentage of phosphorus	0.279	0.279	.223	.167	.223	.927	.167	.167

The metallic iron contained in these ores varies from 45.030 per cent. in No. 2977, down to 31.832 per cent. in No. 2972. The value of the first-named ore is much affected by its large proportion of phosphoric acid, equal to 3.325 per cent. The other ores contain this ingredient in proportions from only 0.167 in Nos. 2975, 2978 and 2979, up to 0.279 per cent. in Nos. 2972 and 2973. All of these ores are valuable.

No. 2971 bis—**Coal** from Whiteboro creek, sent by J. H. Northrop, of Louisa, Ky.

COMPOSITION.—(Air-Dried.)

	Per Cent.		Per Cent.
Hygroscopic moisture	4.00	Total volatile matters	37.80
Volatile combustible matters	33.80		
Light spongy coke	62.20	Carbon in the coke	57.80
		Light-grey ash	4.40
	100.00		100.00
Percentage of sulphur	0.878		

A good coking coal.

Logan County.

No. 2980—**White Limestone** (St. Louis Limestone), from Russellville, Logan county. Sample collected by D. W. Burgher. Received from Frankfort September 16, 1889.

A light-grey, nearly white, fine-oolitic limestone.

COMPOSITION.—(Air-Dried.)

	Per Cent.
Lime carbonate	95,600
Magnesia carbonate	.832
Alumina, iron oxide and phosphoric acid	1.200
Silicious residue	1 200
Moisture and loss	1.168
	100.000

Quite pure limestone, which would yield very white fine lime for all ordinary uses.

MARTIN COUNTY.

No. 2981—**COAL from** Wolf creek. *Geological position*: Lower coal. Average sample from the whole 36-inch face. Collected by A. R. Crandall, June 12, 1889.

COMPOSITION.—(Air-Dried)

Hygroscopic moisture	2.20	Total volatile matters	35.00
Volatile combustible matters	32.80		
Spongy coke	65.00	Carbon in the coke	48.00
		Light-grey ash	17.00
	100.00		100.00
Percentage of sulphur	1.813		

Its large proportions of ash and sulphur would reduce its value for the manufacture of coke, etc.

OHIO COUNTY.

No. 2982—MINERAL WATER, from the Worrell farm, near the line of the Falls of Rough Creek Railroad. Sample obtained by R. S. Triplett. Received from Frankfort July 23, 1889.

COMPOSITION in 1,000 parts of water.

Ferrous sulphate	0.122
Aluminum sulphate	.248
Calcium sulphate	.590
Magnesium sulphate	.687
Potassium sulphate	019
Sodium sulphate	.017
Sodium chloride	019
Silica	.036
In 1,000 parts	1.738

A saline, astringent, chalybeate water.
[See Appendix for an Ohio county *coke.*]

OWSLEY COUNTY.

No. 2983—COAL; on Dick Reynolds' land, South Fork of Kentucky river. Average sample from 20½-inch bed, by G. M. Sullivan, July 27, 1889.

COMPOSITION.—(Air-Dried.)

Hygroscopic moisture	1.20	Total volatile matters	56.00
Volatile combustible matters	54.80		
Dense coke	44.00	Carbon in the coke	35.20
		Light-brown ash	8.80
	100.00		100.00
Percentage of sulphur	0.577		

This appears to be a good *cannel coal.*

PIKE COUNTY.

IRON ORES.

No. 2984—**IRON ORE**, from the farm of J. Harvey Leslie, on Caney branch of John's creek. Sample collected by A. R. Crandall, August 1, 1889.

A yellowish-brown Limonite ore.

No. 2985—**IRON ORE**; on the Hawk Fuller branch of Buffalo creek, on Spencer Boyce's land. Bed 28 inches thick; near the top of the hill. Sample collected by C. N. Brown, August 4, 1888.

A dark-reddish-brown Limonite ore, containing a little organic matter.

COMPOSITION OF THESE PIKE COUNTY IRON ORES.—(Air-Dried.)

Numbers in Report.	2984	2985
Iron peroxide	(a) 58.835	(c) 70.423
Alumina	16.627	9.588
Lime carbonate	1.200	.500
Magnesia carbonate	.605	.227
Phosphoric acid	(b) 2.178	(d) 1.279
Silicious residue	4.600	1.200
Water, etc., and loss	15.955	16.833
	100.000	100.000

(a) Equal to 41.184 per cent. of iron.

(c) Equal to 49.296 per cent. of iron.

(b) Equal to 1.492 per cent. of phosphorus.

(d) Equal to 0.868 per cent. of phosphorus.

PIKE COUNTY COALS.

No. 2986—COAL; A. P. Bevins', on Bend branch of John's creek, Pike county. Average sample from the whole face—upper part 22 inches, lower part 27 inches. Collected by A. R. Crandall.

A bright-looking coal, breaking generally irregularly, with irregular shining surfaces, some small portions laminated, with very little mineral charcoal, and no pyrites apparent.

No. 2987—COAL: 6 feet coal, on the ridge between Caney branch and Little Bushy branch of John's creek. Coal about 625 to 650 feet above the creek. Average sample collected by C. N. Brown, August 23, 1888.

Coal mostly laminated; some mineral charcoal on the laminæ; no bright pyrites apparent.

No. 2988—COAL; on Pond creek. Average sample collected from the whole 62 inches of the face, by A. R. Crandall, August 8, 1889.

No regular parting in the bed.

No. 2989—COAL; on Tug Fork. Average sample from the whole face of the bed. Collected by A. R. Crandall, August 9, 1889. Coal, 2 feet; shale, 15 inches; coal, 43 inches.

No. 2990—COAL; on Turkey creek. Average sample of the whole 23-inch bed—*cannel coal*—badly weathered near the outcrop. Collected by A. R. Crandall, August 9, 1889.

No. 2991—COAL; on Tug Fork, 1 mile above the mouth of Pond creek. Average sample of the 45-inch bed, excluding a 1-inch parting, 14 inches from the bottom. Collected by A. R. Crandall, August 9, 1889.

Ten inches of coal above 8 inches clay shale not included.

No. 2992—COAL; on Tug Fork, two miles above White Post. Average sample from the 6-feet bed (some little clay adhering) taken from near the mouth of the entry, by A. R. Crandall, August 11, 1889.

Three small partings in the bed.

COMPOSITION OF THESE SEVEN PIKE COUNTY COALS.—(Air-Dried.)

Number in Report.	2986	2987	2988	2989	2990	2991	2992
Hygroscopic moisture	1.60	3.80	1.40	2.00	2.10	1.20	1.40
Volatile combustible matters	34.60	28 00	27.20	32.00	44.70	38.40	36.60
Coke	63.80	68.20	71.40	66.00	53.20	60.40	62.00
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	36.20	31.80	28.60	34.00	46.80	39.60	38.00
Carbon in the coke	57.40	57.20	65.00	60.00	45.50	55.00	55.80
Ash	6.40	11.00	6.40	6.00	7.70	5.40	6 20
Totals	100.00	100.00	100.00	100.00	100.00	100 00	100.00
Character of the Coke	spongy.	dense friable.	spongy.	spongy.	dense.	light spongy.	spongy.
Color of the ash	purplish grey.	light grey.	very light grey.	light grey.	brownish red.	grey.	grey.
Percentage of sulphur	1.708	0.590	0.494	0.577	1.606	2.527	2.280

Pike County Coals—Continued.

No. 2993—Coal; on Read branch of Big creek. Average sample of the 70-inch face, excluding a 2-inch parting near the base, and a ½-inch parting 3 feet 4 inches from the top. Collected by A. R. Crandall, August 8, 1889. (Some clay adhering.)

No. 2994—Coal; Cane Hollow. Average sample from the 32-inch bed. (Splint and Block coal, 1½ inches; Bone coal at the middle.) Collected by A. R. Crandall, August 7, 1889.

No. 2995—Coal; on Big creek. Average sample from the 37-inch bed, excluding two 1-inch partings. Collected by A. R. Crandall, August 7, 1889.

No. 2996—Coal; in "Coal Hollow," on Big Creek. Average sample from the 35-inch face. Collected by A. R. Crandall, August 7, 1889.

No. 2997—Cannel; Coal on "Big creek." Average sample from the 32-inch bed, excluding a parting 8 inches from the bottom, by A. R. Crandall, August 7, 1889.

No. 2998—Coal; Shadel Pauley's coal, on Big creek. Average sample from the 4 feet bed. Collected by A. R. Crandall, August 8, 1889.

No. 2999—Coal; at mouth of Peter creek. Average sample from the 62-inch bed, at the outcrop. Collected by A. R. Crandall, November 20, 1889. Some clay adhering to the sample.

COMPOSITION OF THESE SEVEN PIKE COUNTY COALS.—(Air-Dried.)

Number in Report.	2993	2994	2995	2996	2997	2998	2999
Hygroscopic moisture	1.20	1.60	2.60	1.60	1.40	1.60	5.20
Volatile combustible matters	33.20	28.30	34.30	32.80	42.00	35.80	26.00
Coke	65.60	70 10	63.10	65.60	56 60	62.60	68.80
Totals	100.00	100.00	100.00	100 00	100.00	100.00	100.00
Total volatile matters	34.40	29.90	36.90	34.40	43.40	37.40	31.20
Carbon in the coke	61.00	55.90	57.30	56.40	46.40	58.00	59.70
Ash	4.60	14.20	5.80	9.20	10.20	4.60	9.10
Totals	100.00	100.00	100.00	100.00	100.00	100 00	100 00
Character of the coke	pulverulent.	dense.	spongy.	dense spongy.	dense.	light spongy.	pulverulent.
Color of the ash	lt.brown'h grey.	light grey.	grey brown.	light grey.	lt.brown'h grey.	brownish grey.	very light grey.
Percentage of sulphur	0.631	0.681	0.604	1.588	1.098	0.769	0.412

PIKE COUNTY COALS—Continued.

No. 3000—COAL; James H. Coleman's coal, head of Beech Fork of Peter creek. Average sample from the 63-inch bed. Collected bv A. R. Crandall, November 17, 1889.

No. 3001—COAL; Davis' coal, on Peter branch of Blackberry creek. Average sample of the 55-inch bed, by A. R. Crandall, November 20, 1889.

Splint coal, and probably a little shaley, 8 inches from the top, near the outcrop.

No. 3002—COAL; Thompson and Hatfield's, on Blackberry creek. Average sample from the lower five feet at the outcrop. Collected by A. R. Crandall, November 20, 1889. Some little clay adhering.

No. 3003—COAL; at mouth of Holly Fork of John's creek. Harrison Field's coal. Average sample from the 6-feet bed, from the weathered face. Collected by A. R. Crandall, November 19, 1889.

No. 3004—COAL; Elias Hatfield's, on Blackberry creek. Average sample of the 58-inch bed. Collected by A. R. Crandall. (A separate sample of the 6 inches near the top, marked B, was taken for test of ash, which left as much as 28.30 per cent. of ash.)

No. 3005—COAL; Andrew Collins' coal, on Stinking branch of John's creek. Average sample from the lower 50 inches. Collected by A. R. Crandall, November 18, 1889.

No. 3006—COAL; Dotson's coal, from near Jamboree post-office, on Peter creek. Average sample from the 46-inch bed, including 2 inches of bony splint coal. Collected by A. R. Crandall, November 19, 1889.

No. 3007—COAL; from Coon branch of Tug river, near the mouth of Blackberry creek. Average sample of the 39-inch outcrop. Collected by A. R. Crandall, November 20, 1889. Some clay adhering.

COMPOSITION OF THESE EIGHT PIKE COUNTY COALS.—(Air-Dried.)

Number in report.	3000	3001	3002	3003	3004	3005	3006	3007
Hygroscopic moisture	1.80	1.40	2.90	1.60	2.60	1.46	0.80	1.70
Volatile combustible matters	26.20	27.40	26.80	27.94	28.16	31.34	28.40	30.30
Coke	72.00	71.20	70.30	70.46	69.24	67.20	70.80	68.00
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	28.00	28.80	29.70	29.54	30.76	32.80	29.20	32.00
Carbon in the coke	65.80	63.74	65.70	64.26	65.24	56.80	60.80	61.54
Ash	6.20	7.46	4.60	6.20	4.00	10.40	10.00	6.46
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Character of the coke	friable.	dense spongy.	friable.	dense friable.	dense friable.	spongy.	light spongy.	dense friable.
Color of the ash	brownish grey.	brownish grey.	reddish. grey.	grey.	reddish grey.	grey.	dark grey.	reddish grey.
Percentage of sulphur	0.549	0.549	0.494	0.450	0.500	0.727	0.719	0.521

In the above-described 22 coals from Pike county, the *Hygroscopic moisture* is found to vary from only 0.80 per cent. in No. 3006, up to 5.20 per cent. in No. 2999. This difference is probably partly owing to varying atmospheric conditions when the analyses were made. To get the real proportions of the other essential ingredients of the coals, the calculation should be made on the coals dried at a fixed temperature, say at 212° F., a calculation easily to be made of the above reported results.

Of these 22 coals, eleven, at least, are, very probably, good coking coals, as may be seen in the following summary of their essential ingredients, viz:

Number in Report.	Coke—per cent.	Carbon—per ct.	Ash—per cent.	Sulphur—per cent.
No. 2986	63.80	57.40	6.40	1.708
No. 2988	71.40	65.40	6.40	.494
No. 2989	66.00	60.00	6.00	.570
No. 2991	60.40	55.00	5.40	2 527
No. 2992	62.00	55.30	6.20	2.280
No. 2994	70.10	61.00	14.20	.631
No. 2995	63 10	57.30	5.80	.604
No. 2996	65.60	56.40	9.20	1.538
No. 2998	62.60	58.00	4.60	.769
No. 3001	71.20	63.70	7.46	.549
No. 3005	67.20	56.80	10.40	.727
No. 3006	70 80	60.80	10 00	.719

It can be seen in this table that the *coke* obtained from these *coals* ranges from 60.40 per cent. up to 71.40 per cent. The *carbon* contained in these cokes is from 55. up to 65.40 per cent. The *ash* is from only 4.60 per cent., up to 14.20, in a single sample; and the *sulphur* from 0.494 per cent. up to 2.527.

In the *cokes* the percentages of ash and sulphur would, of course, be larger than is calculated in the coals.

It may be interesting to compare with these coals, the composition of some of the best coking coals of Pennsylvania as given in the special report (Second Geological Survey of Pennsylvania)—the Coke Report of F. Platt, 1875—as follows, page 120:

ANALYSES OF THESE TYPES OF THE BEST COKING COALS OF PENNSYLVANIA.

	Connellsville (Pittsburg seam)—per cent.	Bennington (Miller's)—per cent.	Broad Top (Barnet)	Coals (Miller's)
Fixed carbon	59.62	68.50	74.65	71.12
Ash	8.23	8.00	7.50	7.50
Volatile matters	31 36	22.88	16.00	19.68
Sulphur	.784	1.12	1.85	1.70

PULASKI COUNTY.

COALS.

No. 3008—COALS; on Addison branch of Cumberland river. Average sample from the 54-inch face near the outcrop. Hard coal. Collected by A. R. Crandall. (Some clay adhering.)

No. 3009—COAL; Rayburn's coal, Slipup mine. Average sample of the 40-inch face, collected by A. R. Crandall, July 30, 1889.

No. 3010—COALS; on Big Lick creek. Average sample from the 31-inch face. Splint coal, the upper 4 inches cannel coal. Collected by A. R. Crandall. (Some clay adhering.)

No. 3011—COAL; on Bear creek, semi-cannel or bone coal. Average sample of 4 inches at the top of the 42-inch bed. Collected by A. R. Crandall, August 1, 1889.

No. 3012—COAL; on Bear creek. Average sample from the 42-inch face of the bed, exclusive of the semi-cannel at top (the next preceding sample). Collected by A. R. Crandall, August 1, 1889.

No. 3013—COAL; from Happy Hollow. Average sample from the 37 to 39-inch bed, in room 60 feet in the main entry. Collected by A. R. Crandall, July 23, 1889.

No. 3014—COAL; Edwards' mine, Cumberland river, 1½ miles below the mouth of Rockcastle river. Sample from the whole 30-inch bed, in the old entry. Collected by A. R. Crandall,, July 30, 1889.

COMPOSITION OF THESE PULASKI COUNTY COALS.—(Air-Dried.)

Number in Report.	3008	3009	3010	3011	3012	3013	3014
Hygroscopic moisture	2.40	2.00	2.80	1.00	2.40	1.40	3.40
Volatile combustible matters	35.60	34.80	33.80	34 30	34.00	36.20	34.40
Coke	62.00	63.20	63.40	64.70	63.60	62.40	62.20
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters	38.00	36.80	36.60	35.30	36.40	37.60	37.80
Carbon in the coke	54.40	55.20	53.60	44.30	54.20	56 80	57.20
Ash	7.60	8.00	9.80	20.40	9.40	5.60	5.00
Totals	100.00	100.00	100.00	100.00	100.00	100 00	100.00
Charactor of the coke	dense.	spongy.	dense friable.	dense.	spongy.	spongy.	dense.
Color of the ash	brownish grey.	brownish grey.	light grey.	red.	grey.	nearly white.	light grey.
Percentage of sulphur	1.700	1.550	2.580	1.253	0.467	1.043	0.687

Probably only 3 of these Pulaski county coals would yield very good coke, viz: Nos. 3009, 3012 and 3013, the *ash* percentages of which, severally, are 8.00, 9.40 and 5.60; the others, except No. 3014, which gives only 5.00 per cent., give from 7.60 to 9.80 per cent., one single sample, No. 3011, leaving as much as 20.40 per cent. of ash, which diminishes proportionately its value as fuel. In all except Nos. 3012 and 3014, which have only 0.467 and 0.687 per cent, severally, the proportions of sulphur are quite large, varying from 1.043 per cent. in No. 3013, up to 1.700 per cent. in No. 3008.

ROCKCASTLE COUNTY.

COALS.

No. 3016—COAL; from Coffee Branch, of Crooked creek. Average sample of 36-inch bed. Collected by G. M. Sullivan, May 31, 1889.

No. 3017—COAL; "Spiery Coal," from near Livingston. Bed 84 feet above the Subcarboniferous limestone. Average sample from the face of the whole 33-inch bed. Collected by G. M. Sullivan, July 17, 1889.

No. 3018—COAL; on Tarlton Clark's land, known as Clark's bank, Brush creek, 4½ miles from Brush Creek Station on the K. C. railroad. *Geological position:* 85 feet above the Subcarboniferous limestone. Average sample collected by G. M. Sullivan, from the 52-feet face, August 6, 1889.

COMPOSITION OF THESE ROCKCASTLE COALS.

Number in Report.	3016	3017	3018
Hygroscopic moisture	3.80	4.20	4.40
Volatile combustible matters	31.00	33.70	31.00
Coke	65.20	62.10	64.60
Totals	100.00	100.00	100.00
Total volatile matters	34.80	37.90	35.40
Carbon in the coke	56.20	55.90	60.20
Ash	9.00	6.20	4.40
Totals	100.00	100.00	100.00
Character of the coke	dense.	dense friable.	spongy.
Color of the ash	very lt. grey.	lt. bron'h grey.	light grey.
Percentage of Sulphur	0.412	0.968	0.494

No. 3018 is a remarkably pure, good coal, which would, no doubt, make very good coke. The others are not quite as valuable, as seen in their larger proportions of ash, yet are good fuel. The large proportion of moisture is, very probably, partly an accident of the season.

(It is easy to remove this irregular cause of variation by calculating the percentage in the samples, excluding the Hygrometric moisture, which has been expelled at the temperature of about 212° F.)

WARREN COUNTY.

MINERAL WATERS.

No. 3019—*Sulphur Mineral Water*; from a well of Mr. D. E. Mercer, at Rich Pond. Well 105 feet deep, the first 50 feet in clay, the rest in the Saint Louis Limestone. Sample received from Frankfort, in a gallon-jug imperfectly sealed, October 9, 1888.

COMPOSITION; in 1000 parts of the water.

Hydrogen sulphide gas (remaining)	411	Cubic centimeters.
Lime carbonate	0.3000	Held in solution by carbonic acid.
Magnesia carbonate	.0667	
Iron carbonate	.0920	
Sodium chloride	6.5840	
Potassium chloride	.0346	
Magnesium chloride	.6555	
Magnesia sulphate	.1263	
Sodium, sulphate and carbonate	traces.	not estimated.
Silica	.0160	
Not estimated and loss	.0529	
Saline matters in 1000 parts of the water	7.9280	

A saline sulphur water, slightly chalybeate, perfectly wholesome.

No. 3020—MINERAL WATER; from a well bored 175 feet deep, on the public square, Bowling Green. Sample sent by Col. M. H. Crump. Received June 12, 1889.

COMPOSITION; in 1000 parts of the water.

Iron carbonate	0.0080	Held in solution by carbonic acid.
Lime carbonate	.2240	
Magnesia carbonate	.0091	
Sodium chloride	.0897	
Potassium sulphate	.0189	
Sodium sulphate	.2199	
Lime sulphate	.0977	
Magnesia sulphate	.2280	
Silica	.0040	
Saline matters in 1000 parts of the water	0.8893	

A weak saline and very weak chalybeate water, wholesome for all ordinary purposes, but somewhat "hard." Will deposit most of its carbonate of lime on boiling.

WARREN COUNTY.

LIMESTONE.

No. 3021—**LIMESTONE**; a block sent from the McLellan Stone Company's quarry, Rockfield, Warren county, Kentucky, by Mr. James Brown. Received November 21, 1888.

A compact, fine oolitic, light grey limestone, showing no fossils. Some few thin dark lines, not more than a twentieth of an inch thick, run horizontally through the block. These dark laminations were objected to by the architect.

COMPOSITION (Air-dried.)

Carbonate of lime	94.000
Carbonate of magnesia	2.116
Iron peroxide, alumina, etc.	.700
Silica	2.200
Water, etc., and loss	.984
	100.000

It was found that the stone did not cleave on the dark seams, the material of which is of a somewhat ferruginous composition, and probably would be as durable as the rest of the rock, and might even get harder by weathering.

WHITLEY COUNTY.

COALS.

No. 3022—COAL; near Pleasant View, on the Louisville & Nashville Railroad. Outcrop of a 31-inch bed. Sample sent from Frankfort by A. R. Crandall, February 7, 1889. "Will it coke?"

A bright, pure-looking coal.

No. 3023—COAL; a selected sample of Jellico coal, lower portion of the bed. Procter mine, near Red Ash P. O. Brought by A. R. Crandall, March 15, 1889.

A bright, pure-looking coal; bird's-eye structure in part; no fibrous coal or pyrites apparent.

No. 3024—COAL; from same bed; upper portion contains some little fibrous coal.

No. 3025—COAL; H. C. King's, near Mahan Station, Wall's creek. Average sample from the whole 42-inch bed. Collected by A. R. Crandall, May 2, 1889.

No. 3026—COAL; Truman's coal, on Cane creek, near Jellico. Average sample of the whole bed: coal, 34 inches; clay shale, 1 inch; coal, 4 inches. Collected by A. R. Crandall, May 8, 1889.

No. 3027—COAL; from Coal Bank Branch, Carr's Fork of Watts' creek, 3 miles from Rockhold. Average sample from the 48-inch face, without parting. (One inch of bone coal 2 feet from the top.) Collected by A. R. Crandall, May 9, 1889.

No. 3028—COAL; from near "Pleasant View." Average sample from the whole 40-inch face, near the outcrop. Collected by A. R. Crandall.

No. 3029—COAL; head of Cane creek. Average sample from the whole face, 3 feet 9 inches thick, including a 3-inch parting, 8 inches from the bottom. The lower part is splint coal; the lower, third and the upper benches are also. Collected by A. R. Crandall, July 17, 1889.

No. 3030—COAL; Worley's Branch of South Fork of Cumberland river; lower opening 63 inches. Twelve inches of the bottom is semi-cannel coal. Average sample from the outcrop of the whole face. Collected by A. R. Crandall, October 28, 1889.

A somewhat weathered sample. (Some clay adhering.)

No. 3031—COAL; Jellico coal from near Williamsburg. Average sample from the whole face; 31 to 33 inches, 75 feet in the entry. Collected by A. R. Crandall. October 5, 1889.

No. 3032—COAL; *Splint coal,* from near Brummitt's station on the Louisville & Nashville Railroad, near the Knoxville Branch. (Coal belonging to Mrs. Mary E. Varnon, of Stanford, Ky.) Sample sent from Frankfort, received January 6, 1890.

Some mineral carbon and fine-grained pyrites between the laminæ.

No. 3032 (bis.)—"BIRD'S-EYE CANNEL COAL;" Halsey opening. Average sample of the cannel part (lower), 2 feet 4 inches; 6 inches of common coal above, under shale roof with layers of sandstone. The whole of the cannel coal not shown. Collected by A. R. Crandall, March 15, 1889.

Pretty bright "bird's-eye" coal in parts; portions more dull cannel. Some little bright scales of pyrites apparent.

COMPOSITION OF THESE WHITLEY COUNTY COALS.—(Air-dried.)

Number in Report.	3022	3023	3024	3025	3026	3027	3028	3029	3030	3031	3032	3032(bis)
Hygroscopic moisture . . .	n. e.	2.40	2.00	4.60	1.60	1.80	2.40	4.30	5.40	2.00	2.60	1.00
Volatile combustible matters.	n. e.	33.10	36.40	32.80	37.20	37.00	34.80	32.70	33.40	34.76	30.80	43.00
Coke	59.46	64.50	61.60	62.60	61.20	61.20	62.80	63.00	61.20	63.24	66.60	56.00
Totals	. . . .	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total volatile matters . . .	40.54	35.50	38.40	37.40	38.80	38.80	37.20	37.00	38.80	36.76	33.40	44.00
Carbon in the coke	55.76	63.10	60.30	59.00	58.40	57.80	58.80	56.00	58.06	58.44	61.46	48.80
Ash	3.70	1.40	1.30	3.60	2.80	3.40	4.00	7.00	3.14	4.80	5.14	7.20
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Character of the coke . . .	very lt. spongy.	dense spongy.	dense spongy.	dense.	spongy.	spongy.	dense spongy.	dense friable.	pulverulent.	light spongy.	spongy.	very dense.
Color of the ash	grey brown.	lt. grey brown.	lt. grey brown.	lt. bro'sh grey.	lt. bro'sh grey.	lt. grey.	light grey.	bro'sh grey.	lt. bro'sh grey.	lt. bro'sh grey.	light grey.	greyish brown.
Percentage of Sulphur. . .	0.453	0.494	0.714	0.742	0.796	0.961	·0.522	0.906	0.446	1.428	0.659	1.207

With the exception of No. 3029 and No. 3032 (bis) in which the ash is 7.00 and 7.20 per cent., severally, these coals are quite pure from earthy material; the percentages of *ash* falling as low as 1.30 per cent. in No. 3024, and reaching 4.80 per cent. only, in the next highest of the whole, No. 3031.

It is probable that good coke could be made from at least seven of the number, viz: Nos. 3022-3-4-6-7-31 and 3032.

All of them are good fuel, No. 3029 and 3032 bis being somewhat less valuable than the others, in the proportion of their larger ash percentages.

WHITLEY COUNTY COKE.

No. 3033—**COKE**; made of slack coal, from the Jellico vein, Kensee mines. Sample collected by M. E. Thruston, October, 1888.

COMPOSITION.

	Per cent.		Per cent.
Hygroscopic moisture	0.10	Total volatile matters	0.70
Volatile combustible matters	.60		
Dry coke	99.30	Carbon in the coke	84.60
		Grey-brown ash	14.70
	100.00		100.00
Percentage of sulphur	0.961		

The percentage of ash is rather large; otherwise this is quite good coke.

WHITLEY COUNTY.

CLAYS.

No. 3034—**CLAY**; from a bed 5 feet thick, on Indian creek. Sample collected by A. R. Crandall, March, 1889.

A friable, indurated clay of a buff-grey color. Refractory before the blow-pipe.

No. 3035—**CLAY**; "*Jellico clay*," Whitley county and Tennessee. A white, indurated clay. Refractory before the blow-pipe.

COMPOSITION OF THESE WHITLEY COUNTY CLAYS.

Number in Report.	3034	3035
Silica (of which 8.70 per cent. is fine sand)	59.10	84.76
Alumina (with a little oxide of iron)	29.76	11.40
Lime	trace.	trace.
Magnesia	.72	.65
Potash	3.86	1.58
Soda	trace.	.05
Water and loss	6.56	1.56
	100.00	100.00

Both are good fire clays. The large proportion of silica in No. 3035 would make it quite refractory.

MINERAL WATERS FROM WHITLEY COUNTY.

No. 3036—MINERAL WATER; from a spring one mile south of Woodbine, Whitley county. Sample sent by Dr. A. Gatliff, at the request of A. R. Crandall, May, 1889.

No. 3037—MINERAL WATER; from a well 1 mile south of Woodbine. Sample sent by Dr. A. Gatliff. Received May 20, 1889.

COMPOSITION OF THESE MINERAL WATERS.

In 1000 parts of the water.

Number in Report.	3036	3037
Iron carbonate	0.003	trace.
Magnesia carbonate	.016	.016
Lime carbonate	trace	.036
Sodium chloride	.044	.084
Potash sulphate	.049	.029
Magnesia sulphate		.210
Alumina and silica	traces.	.093
In 1000 parts of the water	0.112	0.468

No. 3036 is quite a weak chalybeate water, but both contain so small a proportion of saline matters that they scarcely deserve the name of "Mineral Waters."

TENNESSEE.

No. 3038A—COAL (JELLICO); from East Tennessee Coal Company's mine, main entry, rooms Nos. 9 and 10. The lower part 30 inches thick. "Bone coal," 1 inch, running out in some places. Upper bench 14 inches. Sample collected by A. R. Crandall, March 15, 1889.

No. 3038B—Sample of "*Bone Coal.*"

No. 3039—COAL—"*Mingo Mountain.*" Coal, 23 inches; shale, 2½ to 3 inches; coal, 44 inches; clay, ——. Sample collected by A. R. Crandall, April 17, 1889.

COMPOSITION OF THESE TENNESSEE COALS.—(Air-Dried.)

Number in Report.	3038 A	3038 B	3039
Hygroscopic moisture	2.00	n. e.	4.40
Volatile combustible matters	36.00	n. e.	32.80
Coke	62.00	n. e.	62.80
Totals	100.00	. . . .	100.00
Total volatile matters	38.00	n. e.	37.20
Carbon in the coke	60.00	n. e.	56.60
Ash	2.00	14.70	6.20
Totals	100.00	. . . .	100.00
Character of the coke	dense spongy.	. . . .	dense friable.
Color of the ash	lt.-grey brown.	. . . .	lt. bro'sh grey.
Percentage of sulphur	0.686	0.686	0.824

Both, Nos. 3038 and 3039, are good coals. The bone coal excluded.

(See Whitley county No. 3035 for analysis of a clay common to Tennessee and Kentucky.)

TABLE I.—COALS.—(Air-Dried.)

Number	County	Hygroscopic moisture	Volatile combustible	Coke	Total volatile.	Carbon in coke	Ash	Character of coke	Color of the ash	Sulphur, per cent	Remarks.
2928	Bell.	0.60	52.34	47.06	52.94	26.66	20.40	pulveru'nt.	gr.-brown.	0.370	Cannel coal; mine opposite Pineville.
2929	"	1.20	33.80	65.00	35.00	61.80	3.20	spongy.	lt.-brown.	.549	On Cane fork of Left fork of Straight cr.
2930	"	2.20	34.70	63.10	36.90	58.36	4.74	dn. friable	rd'h-brown	1.126	On Right hand fork of Straight creek.
2931	"	2.06	35.54	62.40	37.60	56.00	6.40	lt. spongy.	dark-lilac.	3.845	On Straight cr., near m. of Kettle Isl'd br.
2932	"	1.00	36.50	62.50	37.50	56.10	6.40	spongy.	pur'h-grey	2.193	Cockerell's coal on Cannon creek.
2933	"	1.20	36.30	62.50	37.50	56.80	5.70	spongy.	pur'h-grey	2.335	Cockerell's coal, Barner seam, Cannon creek.
2934	"	2.00	33.80	64.20	35.80	62.80	1.40	spongy.	lt.-brown.	0.577	Cockerell's coal Cannon cr., bed under san'st.
2935	"	1.20	32.80	66.00	34.00	63.60	2.40	lt. spongy.	lt.-reddish.	0.489	On Bennett's fork of Red river.
2936	"	3.46	30.24	66.30	33.70	62.50	3.80	friable.	lt.-reddish.	0.755	On Bennett's fork near Tennessee line.
2948	Jackson.	1.80	42.40	55.80	44.20	46.60	9.20	dn.spongy.	v'ry lt.grey	0.645	Cannel coal, Deer fork of Horse Lick creek.
2949	"	3.60	33.20	63.20	36.80	56.80	6.40	spongy.	lt.-br.-grey	0.494	Jack Carpenter's coal, Horse Lick creek.
2950	"	3.20	32.80	64.00	36.00	55.80	8.20	spongy.	grey.	0.782	Wells' coal, Sand Lick creek.
2951	"	3.20	32.10	64.70	35.30	51.70	13.00	dn.spongy.	dk-grey.	0.480	On Mace Branch of Big Clover creek.
2952	"	1.70	37.60	60.70	39.30	49.10	11.60	spongy.	grey-br.	2.307	Pete McDaniel's, on Joes' br. of Raccoon cr.
2953	"	4.60	27.30	68.10	31.90	58.10	10.00	dn. friable.	light-grey.	0.522	Of Jake Gabbard's bank, Indian creek.
2954	"	3.40	32.60	64.00	36.00	57.70	6.30	dn.spongy.	pr'h-brown	1.648	On S. Dickson's land, Bell's br. of Indian cr.
2955	"	4.40	36.60	59.00	41.00	55.90	3.10	lt. spongy.	lt.-br.-grey	1.098	Capt. Wilson's "Turkey-foot bk." on T.-foot br. of War Fk. of Station Camp.
2956	"	1.70	35.10	63.20	36.80	58.56	4.64	spongy.	br'sh-grey.	0.824	"Shelton Brock" bed near Collinsworth.
2958	Laurel.	1.20	38.00	60.80	39.20	46.60	14.20	dn.spongy.	lilac-grey.	0.797	Semi-cannel coal 1½ miles from Lily Station.
2959	"	1.80	37.60	60.60	39.40	59.70	0.90	dn. spongy.	white	.810	Mine at Lily on Russellville br. L. & N.R. R.
2960	"	2.00	37.00	61.00	39.00	58.10	2.90	lt. spongy.	grey.	1.085	From Lily.
2961	"	1.80	36.40	61.80	38.20	56.00	5.80	lt. spongy.	lt.pur.grey.	1.650	On "Winding Stair" Gap.
2962	"	1.30	24.70	74.00	26.00	36.46	37.54	pulver'lent	grey-br'wn	4.670	On Indian Camp br., Jno. Brewer's land.
2963	"	1.70	33.50	64.80	35.20	57.20	7.60	spongy.	br'h-grey.	1.785	On W. F. Bray's land, on Craigs creek.
2964	Lawr'nc.	3.00	36.40	60.60	39.40	52.40	8.20	dn. spongy.	red'h grey.	0.961	Head of Straight fork of Donathan creek.
2965	"	6.00	32.40	61.60	38.40	57.40	4.20	dn. spongy.	red'h grey.	.494	Same bed; upper 27 inches.
2966	"	3.00	36.00	61.00	39.00	47.00	14.00	spongy.	pur'h-grey	4.714	Same bed; lower 17 inches.

TABLE I.—Continued

Number . . .	County . . .	Hygroscopic moisture .	Volatile combustible . .	Coke	Total volatile.	Carbon in the coke. . . .	Ash	Character of the coke. .	Color of the ash	Sulphur, per cent. . . .	Remarks.
2967	Law'nce.	3.00	39.00	58.00	42.00	52.00	6.00	lt. spongy.	pur'h grey.	6.450	Same bed; a lump from the bottom.
2968	"	2.20	33.80	64 00	36.00	48.00	16.00	lt. spongy.	"	1.922	On J. Peters' land, Three mile cr., top 37 in.
2969	"	1.80	40.50	57.70	42.30	43.50	14.20	spongy.	"	1.873	On Jacob Peters' land, bottom 18 inches.
2970	"	4.00	39.40	56.60	43.40	46.60	10.00	dn.spongy.	"	.988	"Big Coal," Griffith's creek.
2971	"	1.20	41.80	57.00	43.00	46.00	11.00	friable.	bro'h grey.	.961	Cannel coal, White House, m. White House.
bis.	"	4.00	33.80	62.20	37.80	57.80	4.40	lt. spongy.	light grey.	.878	Whiteboro creek.
2981	Martin.	2.20	32.80	65.00	35.00	48.00	17.00	spongy.	light grey	1.818	Wolf creek.
2983	Owsley.	1.20	54.80	44 00	56.00	35.20	8.80	dense.	lt. brown.	0.577	Dick Reynolds' land, S. fork of Ky. river.
2986	Pike.	1.60	34.60	63.80	36.20	57.40	6.40	spongy.	pur'h grey.	1.708	A. P. Bevins, Bend branch of John's creek.
2987	"	3.80	28.00	68.20	31.80	57.20	11.00	dn. friable.	light grey.	.590	Six feet between Caney br. & Little Burley br.
2988	"	1.40	27.20	71.40	28.60	65.00	6.40	spongy.	vry.lt.grey	.494	On Pond creek.
2989	"	2.00	32.00	66.00	34.00	60.00	6.00	spongy.	light grey.	.577	On Tug fork.
2990	"	2.10	44.70	53.20	46.80	45.50	7.70	dense.	bro'h red.	1.606	On Turkey creek, cannel coal.
2991	"	1.20	38.40	60.40	39.60	55.00	5.40	spongy.	grey.	2.527	On Tug fork, 1 mile above Pond creek.
2992	"	1.40	36.60	62.00	38.00	55.80	6.20	spongy.	grey.	2.280	Tug fork, 2 miles above White Post.
2993	"	1.20	33.20	65.60	34.40	61.00	4.60	pulver'lent	lt br'h grey	.681	On Read branch of Big creek.
2994	"	1.60	28.30	70.10	29.90	55.90	14.20	dense.	light grey.	.681	In Cane Hollow.
2995	"	2.60	34.30	63.10	36.90	57.30	5.80	spongy.	greybrown	.604	On Big creek.
2996	"	1.60	32.80	65.60	34.40	56.40	9.20	dn.spongy.	light grey.	1.588	In Coal Hollow, on Big creek.
2997	"	1.40	42.00	56.60	43.40	46.40	10.20	dense.	lt.br'h grey	1.098	On Big creek, cannel coal.
2998	"	1.60	35.80	62.60	37.40	58.00	4.60	lt. spongy.	br'h grey.	.769	Shadel Pauley's coal, Big creek.
2999	"	5.20	26.00	68.80	31.20	59.70	9.10	pulver'lent	vry lt. grey	.412	Mouth of Peter creek.
3000	"	1.80	26.20	72.00	28.00	65.80	6.20	friable.	br'h grey.	.549	Head of Beech fork of Peter creek.
3001	"	1.40	27.40	71.20	28.80	63.74	7.46	dn.spongy.	br'h grey.	.549	Davis' coal, Peter br. of Blackberry creek.
3002	"	2.90	26.80	70.30	29.70	65.70	4.60	friable.	red'h grey.	.494	Thompson & Hatfield's coal, Blackberry cr.
3003	"	1.60	27.94	70.46	29.54	64.26	6.20	dn. friable.	grey.	.450	H. Fields' coal, m. of Holly fork, John's cr.
3004	"	2.60	28.16	69.24	30.76	65.24	4.00	dn.friable.	red'h grey.	.500	Elias Hatfield's coal, Blackberry creek.
3005	"	1.46	31.34	67.20	32.80	56.80	10.40	spongy.	grey.	.727	Andrew Collins' coal Stinking br, John's cr.
3006	"	.80	28.40	70.80	29.20	60.80	10.00	lt. spongy.	dk. grey.	.719	Dodson's coal, near Jamboree P. O., Peter cr.

3007	Pike.	1.70	30.30	68.00	32.00	61.54	6.40	dn.friable.	red'sh grey	.528	Coon br. of Tug r. near m. of Blackberry cr.
3008	Pulaski.	2.40	35.60	62.00	38.00	54.40	7.60	dense.	bro'h grey.	1.700	Addison's branch of Cumberland river.
3009	"	2.00	34.80	63.20	36.80	55.20	8.00	spongy.	bro'h grey.	1.550	Rayburn's coal, Slipup mine.
3010	"	2.80	33.80	63.40	36.60	53.60	9.80	dn.friable.	light grey.	2.580	On Big Lick creek.
3011	"	1.00	34.30	64.70	35.30	44.30	20.40	dense.	red.	1.258	On Bear creek, 4 inches of the top.
3012	"	2.40	34.00	63.60	36.40	54.20	9.40	spongy.	grey.	0.467	On Bear creek, sample of lower 42 inches.
3013	"	1.40	36.20	62.40	37.60	56.80	5.60	spongy.	nearly whi.	1.048	From "Happy Hollow."
3014	"	3.40	34.40	62.20	37.80	57.20	5.00	dense.	light grey.	0.687	Edward's mine 1½ m. below m. Rockcastle r.
3016	Rock'tle.	3.80	31.00	65.20	34.80	56.20	9.00	dense.	vr. lt. grey.	.412	Coffee branch of Crooked creek.
3017	"	4.20	33.70	62.10	37.90	55.90	6.20	dn.friable.	lt.br'h grey	.968	Spiery coal, from near Livingston.
3018	"	4.40	31.00	64.60	35.40	60.20	4.40	spongy.	light grey.	.494	Clark's bank, Brush cr., 4½ m. from Station.
3022	Whitley.	n. e.	n. e.	59.46	40.54	55.76	3.70	vr.lt.spngy	greybrown	.453	Near Pleas.View, L. &. N. R. R. Will it coke?
3023	"	2.40	33.10	64.50	35.50	63.10	1.40	dn.spongy.	lt.grey bro.	.494	Procter mine near Red Ash P. O. Sel'd sam.
3024	"	2.00	36.40	61.60	38.40	60.30	1.30	dn.spongy.	lt.grey bro.	0.714	From Procter mine, upper part.
3025	"	4.60	32.80	62.60	37.40	59.00	3.60	dense.	lt.grey bro.	.742	H. C. King's, near Mahan station.
3026	"	1.60	37.20	61.20	38.80	58.40	2.80	spongy.	lt.br'h grey	.796	Truman's coal, Cane creek, near Jellico.
3027	"	1.80	37.00	61.20	38.80	57.80	3.40	spongy.	light grey.	.961	Coal Bank br. Carr's fork of Watts' creek.
3028	"	2.40	34.80	62.80	37.20	55.80	4.00	dn.spongy.	light grey.	.522	From near Pleasant View.
3029	"	4.30	32.70	63 00	37.00	56.00	7.00	dn. friable.	br'h grey.	.906	From head of Caney creek.
3030	"	5.40	33.40	61.20	38.80	58.06	3.14	pulver'lent	lt.br'h grey	.446	Worley br. of S. fork of Cumberland river.
3031	"	2.00	34.76	63.24	36.76	58.44	4.80	lt. spongy.	lt.br'h grey	1.428	Jellico creek near Williamsburg.
3032	"	2.60	30.80	66.60	33.40	61.46	5.14	spongy.	light grey.	.659	Near Brummet's Station, L. & N. R. R.
bis.	"	1.00	43.00	56.00	44.00	48.80	7.20	very dense.	grey'h bro.	1.207	Bird's-eye cannel, Halsey opening.

TENNESSEE COALS.—(Air-Dried.)

3038A	. . . .	2.00	36.00	62.00	38.00	60.00	2.00	dn.spongy.	lt. grey br.	.686	Jellico coal, East Ten. Coal Co. mine.
3038B	. . . .	n. e.	n. e.	n. e.	n. e.	n. e.	14.70	. . . . .	. . . .	.686	Jellico coal, sample of the Bone Coal.
3039	. . . .	4.40	32.80	62.80	37.00	56.60	6.20	dn. friable.	lt.br'h grey	.824	Mingo Mountain.

PENNSYLVANIA COKING COALS—(Air-Dried)

Number	County	Hygroscopic moisture	Volatile combustible matters	Coke	Total volatile matters	Carbon in the coke.	Ash	Character of the coke	Color of the ash	Per cent. of sulphur.	Remarks.
...	...	31.86		...	...	59.62	8.28	...	...	.784	...
...	...	22.38		...	...	68.50	8.00	...	...	1.12	...
...	...	16.00		...	...	74.65	7.50	...	...	1.85	...
...	...	19.68		...	...	71.12	7.50	...	...	1.70	...

TABLE II.—COKES.—Air-Dried.

Number	County	Moisture at red heat	Carbon	Ash	Sulphur	Color of the ash	Owner of the coke	Hours of coking	Remarks.
2937	Bell.	0.70	99.30	4.40	0.492	grey-brown.	Pine Mt.Ir.C.	72	Made from the "run of the mine."
3083	Whitley	0.70	84.60	14.70	.961	grey-brown.	...	...	Made of slack coal, Jellico vein, Kensee mines.
2957(3	Johnson.	4.40	88.60	7.00	.576	grey.	...	...	From coal of Greasy creek.
3040	Ohio.	1.70	77.40	19.60	1.648	light-grey.	...	...	

TABLE III.—IRON ORES—(Air-Dried.) (LIMONITE.)

Number . . .	County . . .	Iron peroxide.	Alumina . .	Lime carbonate . . .	Magnesia carbonate . .	Phosphoric acid . . .	Silicious residue	Moisture and loss	Iron	Phosphorus .	Sulphur . . .	Remarks.
2938	Bell.	60 023	5.148	trace.	0.180	0.639	19.500	19.500	42.168	0.279	0.412	Oriskany ore, Straight creek.
2989	"	71.120	13.680	1.900	2.160	3.110	16.932		49.784	1.340	1.098	Lock's iron ore, Kettle Island branch.
2947	Floyd.	55.526	0.568	12.100	2.497	2.046	5.000	12.263	38.868	.893	Not estimated.	From Cane branch of Beaver creek.
2972	Law'nce	45.475	9.525	trace.	.378	.639	34.000	9.982	31.832	.279		Bed at See Gap.
2973	"	52.469	19.732	"	trace.	.639	23.300	13.860	36.735	.279		Straight creek fork of Three-mile creek.
2974	"	54.185	7.423	"	.454	.512	16.000	11.426	37.930	.228		Head of Three-mile creek.
2975	"	63.313	9.444	"	.076	.383	12.400	14.384	44.319	.167		Same locality.
2976	"	57.029	5.999	"	.156	.512	25.400	10.904	39.920	223		Walbridge's station on Chattaroi railroad.
2977	"	64.329	16.786	"	.151	3.325	9.400	16.009	45.080	.927		Peck's station, Griffith's creek.
2978	"	54.506	5.151	14.800	2.052	.383	3.800	9.308	38.154	.167		Head of Griffith's creek.
2979	"	60.786	17.771	.600	.681	.383	13.600	16.179	42.550	.167		North of Louisa.
2984	Pike.	58.835	6.627	1.200	.605	2.178	4.600	15.955	41.184	1.492		J. H. Leslie's, Cane branch of John's cr.
2985	"	70.423	9.538	.500	.227	1.279	1.200	16.823	49.296	.868		On Hawk Fuller br. of Buffalo creek, on Spencer Boyce's land.

CARBONATE IRON ORE.

3015. Laurel. Sample from near Lily, on Laurel river, containing 32.766 per cent. of *iron*.

TABLE IV.—LIMESTONES—(Air-Dried.)

Number . . .	Lime carbonate.	Magnesia carbonate . . .	Alumina . . .	Iron peroxide .	Phosphoric acid.	Potash	Soda	Silicious residue.	Moisture and loss	County	
2746B	. . . .	n. e.	n. e.	n. e.	7.935	n. e.	n. e.	n. e.	. . . .	Fayette.	Phosphoric acid in various thin layers in the Blue Limestone. The highest proportion yet found is about 31 per cent.
2746C	. . . .	“	“	“	2.982	“	“	“	. . . .	“	
2746D	. . . .	“	“	“	3.136	“	“	“	. . . .	“	
2746E	. . . .	“	“	“	29.73	“	“	“	. . . .	“	
2746F	. . . .	. . . .	. . . .	. . . .	3.30	“	“	“	. . . .	“	
2957	77.290a	7.870	0.330	0.330	0.383	tr.only.	tr.only.	4.900	8.235	Jefferson	From bed in the cannel.
2980	95.600	.832	1.200	1.200	n. e.	n. e.	n. e.	n. e.	1.168	Logan.	St. L. Limestone from Russellville.
3021	94.000	2.116	0.700	0.700	n. e.	n. e.	n. e.	2.200	. . . .	. . .	

(a.) Also 0.992 per cent. of lime sulphate.

APPENDIX.

OHIO COUNTY—Continued.

No. 3040—**COKE**; sent by the Hon. R. S. Triplett, received January 24, 1890. Made of coal No. 1, B. stratum 54 inches, thin shale parting 4 inches, and upper coal 15 inches. From line of the O. F. G. R. R., Ohio county. Coke made on the ground. Block coal.

COMPOSITION.—(Air-Dried.)

	Per cent.		Per cent.
Hygroscopic moisture	1.70	Total volatile matters	3.00
Volatile combustible matters	1.30		
Coke	97.00	Carbon in the coke	77.40
		Light-grey ash	19.60
	100.00		100.00

Percentage of sulphur 1.648

The large percentage of ash and rather more than a good average of sulphur lessen the value of this coke.

THE CONDITIONS OF SULPHUR IN COALS.

It has been believed for some time past that a portion of the sulphur in coals is in a free or uncombined condition, while another portion is in some unknown form of organic combination. It is a well-known fact that vegetable and other organic substances, when undergoing decomposition in water containing sulphates of iron, lime or magnesia, etc., may reduce the salts to sulphides, with production of Hydrogen sulphide in the case of lime and magnesia sulphates; conditions which may have been present during the formation of coal.

As hydrogen sulphide (H_2S) is decomposed by contact with the air; the sulphur being deposited; it can easily be seen that coals may frequently contain free sulphur, or some form of sulphuretted organic compound or mineral charcoal from this cause.

In 1873-4, the present writer analyzed, for free sulphur, a fibrous coal or mineral charcoal from Muhlenburg county, Ky., by treating it with purified carbon bi-sulphide, and found in it a notable quantity, also sulphate of lime. (See reports of Geological Survey of Kentucky, New Series, vol. 1, lower paging 287.)

Subsequently he learned that Professor T. G. Wormley, early in 1870, then chemist to the Geological Survey of Ohio, had ascertained that the proportion of sulphur found in coals was frequently greater than sufficed to combine with the iron present in them as bi-sulphide, a fact which has been verified in many cases by other chemists, and he asked the question, "does sulphur combine in any form with the carbon of the coal?" (*Report of the Ohio Geological Survey*, vol. 1, page 360.)

The process above described, for separation of sulphur, was used by the present writer in six samples of coal No. 7, from Willard, Carter county. Collected by Mr. Geo. Gibbs, at the instance of Prof. James P. Kimball, Ph. B. and Mr. H. W. Bates, in 1879, and in each case uncombined sulphur was obtained by him, varying in quantity from 0.012 to 0.060 per cent.

In addition to this *free sulphur* found in some coals, a certain amount of sulphur may exist in them in chemical combination with the coal itself.

On boiling portions of the samples of Carter county coals above mentioned, in a watery solution of carbonate of soda, to ascertain the amount of sulphuric acid present in them, the filtered decoction thus obtained was highly colored, in some samples, from the presence of organic matter, especially that from a greatly weathered sample from Buzzards' Roost Entry, Willard.

To ascertain the nature of this organic matter, twenty grammes of this coal, finely pulverized, air-dried, were boiled in a solution of twenty grammes of carbonate of soda, and the dark-brown decoction thus obtained was filtered and acidulated with Hydrochloric acid, which threw the organic matter down as a dark-brown precipitate, which, when dried at 212° F., weighed 0.15 of a gramme, equal to 0.70 per cent. of the air-dried coal, which quantity might, probably, have been somewhat increased by further digestion of the coal in the alkaline solution.

This organic or bituminous matter, resembling humus in some of its properties, brownish-black when dry, was only slightly soluble in strong alcohol; insoluble in ether, and bisulphide of carbon, and burned without leaving a notable quantity of ash.

Examined for its proportion of *sulphur* by oxidation in a mixture of nitric acid and Chlorate of Potash, etc., and estimating it as barium sulphate, it was found to contain 0.0146 per cent. of its weight of sulphur. It is highly probable that in the unweathered coal, the combined sulphur is in much larger proportion, as it is now well-known that, when exposed to the air, the combined sulphur oxidates, and may be washed out by water as sulphuric acid and soluble sulphates. This formation of acid, under these circumstances, may be observed on the "Ebonite" plates used in some forms of electrical machines, the surfaces of which, on exposure to the air, become covered with acid moisture, caused by the oxidation of the sulphur of the highly *vulcanized* caoutchouc of the plates by the oxygen and moisture of the atmosphere.

Caoutchouc, which is a compound of carbon and hydrogen (C_4 H_7) readily combines with sulphur, which greatly modifies its properties, as is exemplified in the numerous forms of what are denominated vulcanized rubber, in which it is in proportions of 2 to 10 per cent. in the softer varieties, and in the harder varieties the sulphur is not only in chemical combination with the caoutchouc, but also a large proportion is held, as it were in mixture, in that substance, up to 30 per cent. in some cases. As is well known, this combined sulphur gives toughness, durability and hardness to the native hydro-carbon caoutchouc, according to the quantity present.

The presence of a certain quantity of sulphur in some cannel coals, may be the cause of their remarkable toughness; thus the celebrated Breckinridge coal of Hancock county, remarkable for its toughness, was found, on analysis (see Chemical Report in Volume 2, O. S., page 212 of Kentucky Geological Survey Reports), to contain as much as 2.476 per cent. of sulphur. Other coals, such as tough so-called "Block coal," may possibly owe their toughness to the same cause.

A remarkable fact, reported by Mons. Th. Sidot (*Comptes Rendus*, LXX., page 605, March, 1870 *), illustrates the influence of sulphur on the tenacity of charcoal or carbonaceous substances, which, when heated in an atmosphere of carbon di-sulphide, gained in weight and tenacity by combination with sulphur, as follows:

Placing a stick of wood in a porcelain tube, displacing the air by the vapor of carbon di-sulphide, and then gradually heating it to redness, keeping up this heat for an hour, the wood, on cooling, was found to have changed into a coal very different from ordinary charcoal, even when very soft wood or cork was used. Especially was it highly sonorous, resembling in this respect the most sonorous metals, such as steel, silver, aluminum, etc., or glass.

Subsequently, he heated in this manner, a small oak-wood bell, which thus became as sonorous as a metal bell of the same dimensions. The coal obtained by this process differed from common charcoal in its elasticity, and its great conductability of heat and electricity, so that he recommended it for the carbon cylinders of Bunsen's battery. Moreover, he found that it far excelled the gas retort carbon in the intensity of light which it emitted under the influence of an electric current, and, therefore, would be admirably suited for electric lighting; and he states that he obtained the same result with flax, hemp, cotton, paper and silk; thus, to some extent, anticipating and improving on Edison in his use of paper charcoal for this purpose.

This peculiar charcoal, prepared from wood, had a metallic lustre on its surface, was more dense than wood charcoal, and did not notably absorb gases. It acted like a metal when heated, becoming gradually white hot without taking fire in one spot like charcoal, and cooled quickly when removed from the fire, because of its good heat conducting power.

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* Copied into Polytechnic Journal, Dingler, CXCVI—472, and in CXCV—34 7.

This change of charcoal into a dense coal, was not owing entirely to the absorption of sulphur, but most probably, also to the chemical union of hydrogen with the organic matter during the process of charring; for M. Sidot found that the same result could be obtained by charring the material in an atmosphere of wood alcohol vapor, or of a hydro-carbon. This is rendered the more probable, he states, by the circumstance, that when the wood is heated in a porcelain tube, in a current of the vapor of methylic alcohol the interior of the tube becomes lined with light, shining coal filaments.

These experiments of Mons. Sidot, as well as the vulcanization of caoutchouc, illustrate the tendency of sulphur to unite with compounds of hydrogen and carbon, as do also the mineral called Tasmanite, and numerous organic compounds. The singular mineral, Tasmanite, so-called from the locality, Tasmania, in which it is found, a brownish-red mineral, in translucent scales, is composed of carbon, 79.3 per cent; hydrogen 10.4 per cent., oxygen 4.9 per cent, and sulphur 5.3 per cent.

Some of the essential constituents of animals and vegetables have somewhat analagous compositions; thus, the dried albumen of the white of eggs, consists of carbon 54.3 per cent., hydrogen 7.1 per cent., oxygen 21.0 per cent., nitrogen 15.8 per cent. and sulphur nearly 2.0 per cent.; and the albumen of animal blood, the fibrine of their muscles, the curd of their milk, have similar compositions.

No animal could exist without the essential sulphur in the organic constituents of its fluids and solids, and these seem to be derived from the vegetables which primarily or secondarily constitute their food, in all of which sulphur is found in organic composition with hydro-carbons, nitrogenous or non-nitrogenous; hence, it is not wonderful that it is to be found in organic combination in coals, which originate mainly from the partial decomposition of vegetable bodies, during which decomposition sulphur may also be derived from other sources above referred to.

"A sample of cretaceous anthracite brought from Peru, yielded by analysis, according to Dr. Percy,* 10.35 per cent of sulphur, and only 3.75 per cent. of ash. Of this excessive proportion of sulphur, only 3.52 per cent. was evolved on heating the coal for an hour without access of air at an intense white heat. (!) The ash consisted principally of silicate of alumina, and contained only 0.018 per cent. of sulphur. The retention, by the carbonaceous matter, of so large a proportion of sulphur in excess of any possible combination in the ash points, as suggested by Dr. Percy, to the combination of the larger part of the sulphur in this coal with its organic constituents. Another example, leading to the same inference, is given by Dr. Percy.

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* Percy on Fuel, Appendix, page 567.

"A miocene coking coal from New Zealand, yielded 2.50 per cent. of a white ash, and proved to be free from any sulphate soluble in hydrochloric acid; hence, the suggestion that the sulphur may exist in the coal in the same state in which it exists in albumen, fibrin, hair, etc." *

These facts throw much light on the generally large proportion of the sulphur of coals which is retained in the cokes made from them, even when their ash material shows no equivalent amount of iron, lime or magnesia.

Sulphur in coals may exist in several different conditions:

1. It undoubtedly exists in them in a free or uncombined condition, especially in *unweathered* coals.

2. It is found in coals combined with iron as sulphide or bi-sulphide—different forms of pyrites.

3. It is present in organic combination with the hydro-carbon of coals.

4. It may be present, especially in *weathered* coals, in the form of free sulphuric acid or of sulphates of iron, lime or magnesia.

These facts were measurably verified in the analyses made in 1879 by the present writer, of the samples of coals from Carter county, Ky., referred to above; samples which were carefully collected from the coal No. 7, Coalton coal, near Willard, by Mr. Gibbs, with special reference to this investigation.

The following table of the results of the analyses of four samples, two of *highly weathered*, and two of the *unweathered coal* of the interior of the mines, illustrate the effects of the exposure to the atmospheric agencies to which the first named samples had been subjected.

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* Prof. Jas. P. Kimball, "Relations of Sulphur in Coal and Coke," etc., 1879.

COMPOSITION, equally air-dried, of the four Carter County Coals.

	Average per cent. of two unweathered samples . . .	Average per cent. of two weathered samples . . . .
Hygroscopic moisture	5.98	7.08
Volatile combustible matters	34.92	33.05
Fixed carbon in the coke	53.82	53.42
Ash	5.28	6.45
Total sulphur in the coal	2.241	1.669
Total sulphur in the coke	1.386	1.036
Sulphur lost in coking	.874	.683
Free sulphur extracted by carbon bi-sulphide	.036	.022

It can be seen in this table that, while the relative proportions of volatile combustible matters seem to have been only slightly reduced, and the fixed carbon in the coke but little altered by the long process of weathering; the proportion of ash is notably increased, an effect which may be partly owing to the formation of earthy sulphates in the coal, partly to the removal by oxidation of the organic matter of the coal. But the most marked change is to be seen in the proportion of sulphur, which appears to have been diminished in all its forms by the weathering process, partly, no doubt, by its slow oxidation by the atmospheric agencies, and its escape in the form of soluble sulphates washed out by water, and partly as volatile sulphurous acid.

Sulphur in the form of sulphates of iron, alumina, lime and magnesia is found in coals, more especially in coals which have been long exposed to atmospheric agencies—air and water—the results of the oxidation of the sulphur and sulphides contained in them.

To ascertain the presence and relative proportions of these sulphur compounds in the *weathered* and *unweathered* samples of the coals from Willard, Carter county, collected by Mr. Geo. Gibbs at the instance of Prof. Kimball and Mr. H. W. Bates, the following process was adopted: twenty grammes each of the several finely powdered samples were digested for 48 hours in pure distilled water, kept at the temperature of about 200° F. during the daytime. The solution was filtered and the coal on the filter thoroughly washed with distilled water.

The watery solutions, each divided into two portions, were analyzed, the one to ascertain the amount of sulphuric anhydride, the other for the several bases. The coals on the filters transferred to beakers, were digested for four hours in a weak solution of hydrochloric acid, to dissolve out any basic sulphate of iron or sulphate of lime, etc.; and the amount of sulphuric acid ascertained by barium chloride, etc. The results of these examinations are given in the following table, in percentages of the coals.

COMPOSITION.

	NUMBER AND CHARACTER OF THE SAMPLES.					
	2. Unweathered	5. Unweathered	1. Weathered . .	4. Weathered . .	3. Unweathered	6. Unweathered
Sulphuric anhydride in the watery solution	0.195	0.069	0.266	0.470	0.189	0.078
Sulphuric anhydride in the weak acid solution	.059	.044	.092	.034	.058	.028
Percentage of sulphur equal to the total sulphuric anhydride	.103	.041	.148	.201	.079	.040
Iron sulphate in the watery solution	.248	.074	.465	.026	.227	.103
Lime sulphate in the watery solution	.089	.025	.082	.665	.082	.026
Magnesia sulphate in the watery solution	015	.007	.018	.099	.009	.006
Alumina sulphate in the watery solution			a trace;	not estima	ted.	

The practical significance of this table is in the relative proportions of sulphur found in the weathered and unweathered coals.

The unweathered coals, 2 and 5, gave, severally, 0.103 and 0.041 per cent. of sulphur; the mean of the two being 0.072 per cent; while the weathered samples, 1 and 4, gave 0.143 and 0.201 per cent.; the mean being 0.172 per cent.

Moreover, the other two unweathered samples, Nos. 3 and 6, gave only 0.079 and 0.040 per cent. of sulphur severally, in their sulphates, their mean proportion being only 0.0595 per cent.

All going to show, that a portion of the sulphur of the coals had been oxidated into sulphuric anhydride in the weathering process, with the production of sulphates, which, being more or less soluble, could be washed out by water, or might remain in the coal as more or less soluble salts.

Not only are sulphates of iron, alumina, lime and magnesia found in weathered coals, but also in the beds of clay found associated with the coal-beds, causing a saline efflorescence on drying, and affecting the quality of the material. Hence, workers in clays find it advantageous to wash them in preparation for some uses. It is recommended, that in the analysis of coals, for the determination of their sulphur, the pulverized coal should be first digested in a weak mixture of hydrochloric acid and water, to remove and estimate the sulphur contained in the form of acid or in the sulphates.

The organic or ultimate analyses of the two samples of the *unweathered* Carter county coal, Nos. 2 and 5, made at the time stated, was as follows:

COMPOSITION, Dried at 212° F.

	No. 2. Per cent. . .	No. 5. Per cent. . .
Carbon	73.842	72.853
Hydrogen	4.946	4.814
Sulphur	2.262	2.523
Oxygen and nitrogen, *by difference*	13.413	13.370
Ash	5.537	6.440
	100.000	100.000

The considerable proportion of sulphur which may remain in cokes, even when they have been subjected to a very high temperature in the oven, may, according to the facts and analyses above given, be partly in the condition of organic combination with the hydro-carbon of the coke, and partly in combination with iron, lime and magnesia, as partly decomposed iron sulphide and lime and magnesia sulphates. In the smelting of iron, the lime and magnesia sulphates are believed to exert no injurious influence on the iron, they being removed in the slag without undergoing decomposition, but it is probable that sulphur may be transferred to the iron both from the organic sulphurous compound and the partly decomposed iron sulphide and sulphate present.

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